APRIL 23, 1938

ELECTRICAL WORLD

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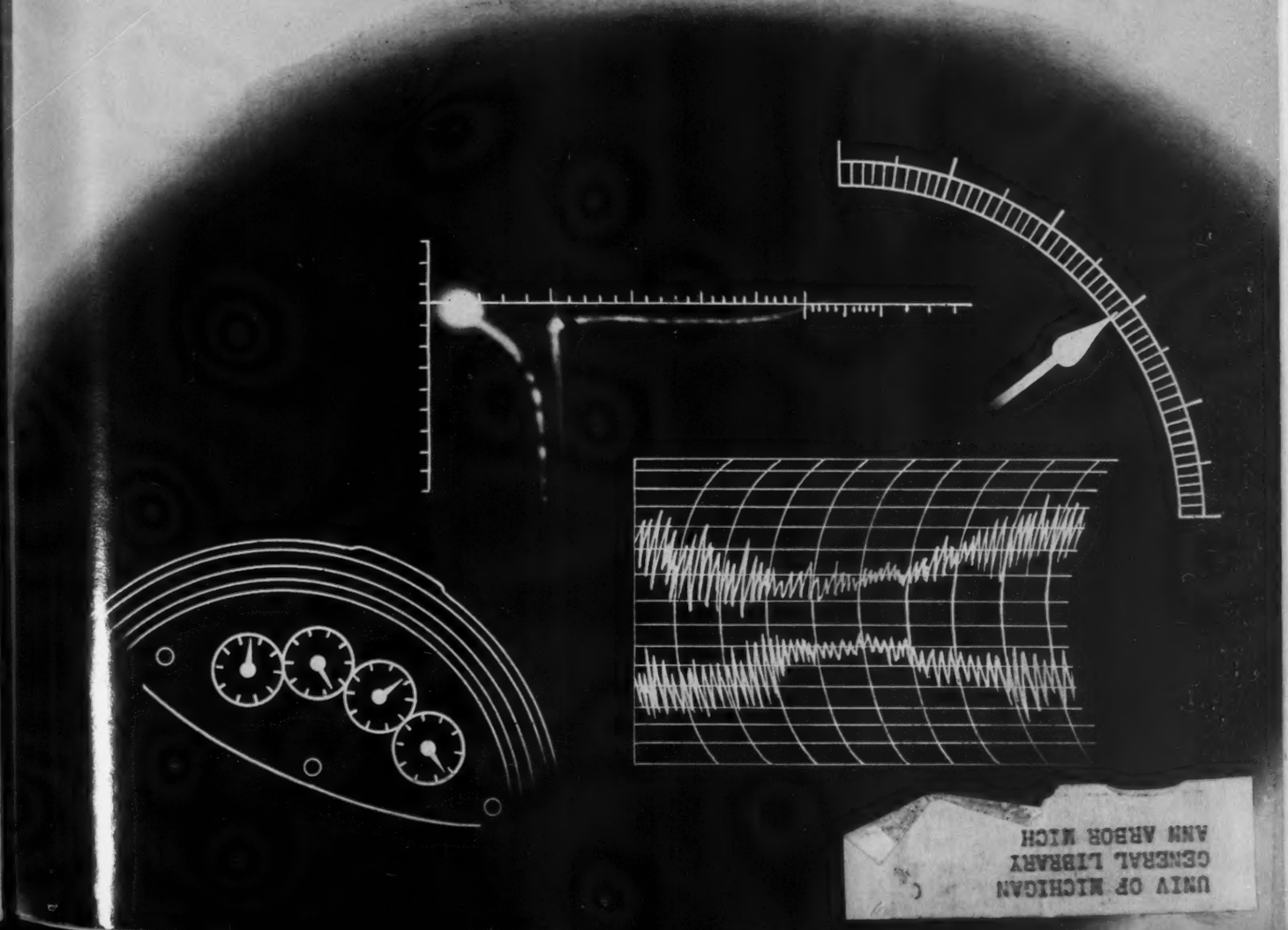

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ELECTRICAL WORLD

APRIL 23, 1938

What's the Utility Picture Like?

Everywhere we go the question is the same —"How's business? What's the utility picture like?"—and the answer is always optimistic—not because we want to be little Pollyannas, but because that's the way things look to us. For instance:

The *Business Week* index shows that business generally is off 24 per cent from a year ago. Industrial activity in durable goods is off twice as much or more. Kilowatt-hour production, on the other hand, is off only 8½ per cent from a year ago, thus reflecting the stabilizing factor of residential consumption. Since the bulk of the reduced usage comes in the industrial bracket, it should be obvious that the revenue picture shows a smaller reduction over last year. Moreover, any substantial gain in industrial production can quickly erase any reduction in output. It must, therefore, be obvious that the electric utility industry is bound to be one of the first to show gains over 1937.

The next thing we see is a decidedly improved public sentiment toward private utilities. Where five years ago newspaper after newspaper enjoyed sniping at the utilities, the important ones are now asking for a fair deal for the power companies. Also, the record shows that there has been a constantly decreasing percentage of votes cast for municipal ownership.

Most of the litigation on major problems occasioned by adverse or restrictive legislation or government competition has been settled, and while the decisions were in favor of government rather than the utilities, the mere fact that the issues have been settled is a point in favor of progress. Until the decisions were rendered the element of fear of the unknown was a strong retarding factor. When investors know what the situation really is, financing can proceed, provided the time is right, on a mutually satisfactory basis.

The investigation of TVA is another point in favor of the private utilities, because with any kind of a fair hearing the unsoundness of the TVA yardstick and the authority's entire power policy will become so apparent as to cause remedial congressional action.

The threat of the "death sentence" has not been as serious as it appeared to be when the law was first enacted. The SEC gives every indication of operating in a manner designed to cause the minimum amount of embarrassment to sound financial programs. In fact, the financial housecleaning that has taken place in certain holding company set-ups should prove to be advantageous to the utility industry in future financing operations.

There are problems, of course, problems of taxes, lower income per unit of output, higher costs, diminishing margin of net, etc. There is also the spectre of coming peaks and how to finance the equipment to carry them. And these are real problems, that will in many cases tax managerial ability. These problems, however, are not confined to the electric utility industry. They will be found to be fairly common to all industry.

Nevertheless, for the reasons given above, the picture as a whole is better today, barring perhaps a slight recession in load, than it has been at any time in the past five years. When business improves and the financial markets are again seeking new investments it may be that there will still be some power companies that cannot readily find equity money, but by and large the industry should be in a position to compete with other industry for the necessary capital at favorable rates.

Hemp-Cored Conductors

By E. V. STUART . . . L. M. ROBERTSON

General Foreman Transmission Lines *Transmission and Station Engineer*
Public Service Company of Colorado

JUST as the hour of sundown changes gradually, almost imperceptibly, until one day we are surprised to find it bright at 5:30, so does a physical structure deteriorate until its accumulation of wear is brought suddenly to our attention. This doubtless is why so many power systems during the past year have found it necessary to recondition transmission lines built many years ago, and which, in numerous cases, carried conductor with a center stand of hemp.

Such has been the experience of the Public Service Company of Colorado, and in this experience there are, perhaps, data which will simplify the task of those systems which must confront such conditions this year or next.

A sketch of background may add significance to the experience, because, first, the necessity for reconductoring grows out of factors which have operated through an extended period of time, and second, the lines under discussion contain within themselves a history of developments in transmission practice.

The Shoshone-Denver line is a 155-mile, 100-kv. structure traversing a considerable stretch of mountainous terrain, as indicated in Fig. 1. Lying between altitudes of 5,000 and 13,325 ft., much of the route is extremely rough and accessible only a few months of the year.

The Shoshone-Denver line (as well as the Boulder Canyon-Denver line) was built in 1908-09, at which time the use of suspension insulators had not previously been tried. This, therefore, was a venture of considerable magnitude, with no tests or experience to indicate procedure.

Original insulation consisted of Hewlett-type insulators, four being employed on both suspension strings and dead-ends. These, proving insufficient, were later increased to five on suspension, six at dead ends. Copper links through the insulator, connected by small single-bolt clamps, were used to couple the units together. The large spacing which resulted did

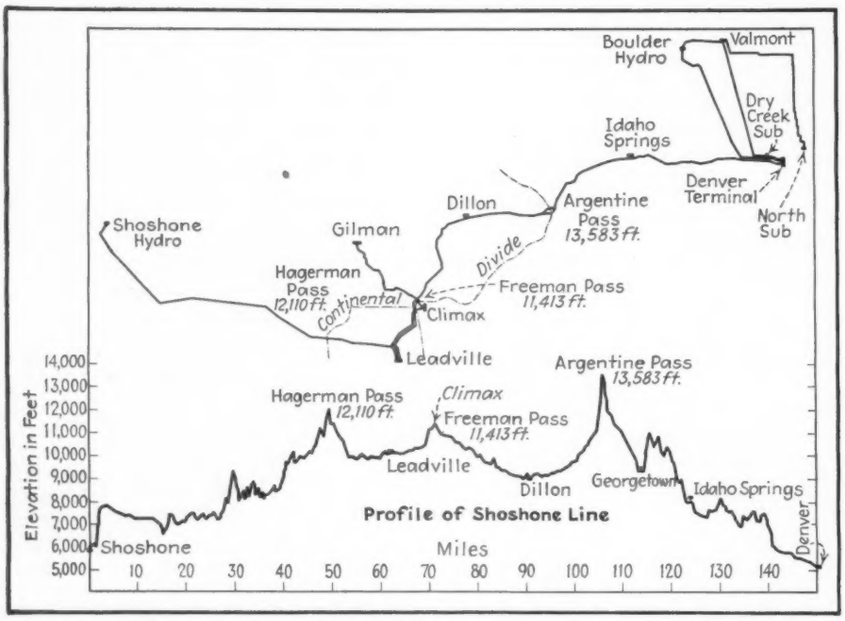
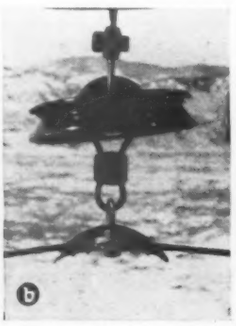
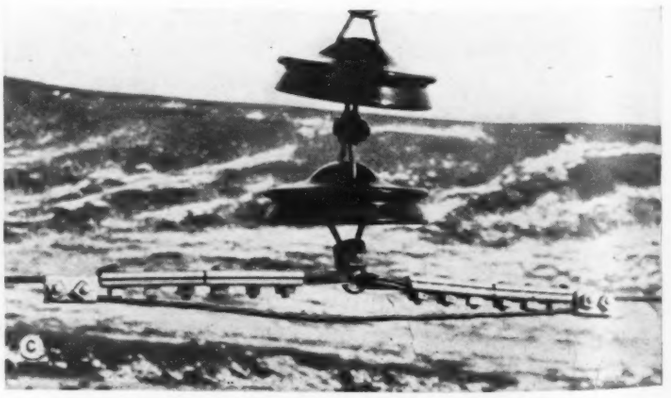


Fig. 1—Profile of Shoshone 100-kv. line suggests rugged terrain, high altitudes and low temperatures





(a) Original hardware used in 1909 lacked modern characteristics.
(b) Saddle clamp subsequently developed.
(c) Suspension construction used in place of saddle clamp.

Fig. 2—Evolution of the hardware

Replaced in Novel Procedure

not, at the time, appear to be detrimental.

To hold conductor, the original job (Fig. 2a) included a small, single-bolt, parallel-groove clamp at suspension points. It was without either bell mouth or saddle seat. Its obvious disadvantages led to development of the first saddle clamp (Fig. 2b). Built of bronze, this was similar to the clamp of today and, although not of perfected design, gave a fairly good account of itself.

Dead-end construction consisted of looping the conductor through a thimble and back on itself, holding it with a parallel-groove clamp. Later, conventional dead-end clamps were installed.

Each of these factors contributed its share toward injuring the original conductor, which was six-strand No. 1 and No. 1/0 copper with a center strand of hemp to add diameter and prevent corona.

It was about ten years after installation that the line began to give trouble. Line breaks would occur and, being at high altitude, the hemp-centered conductor was insufficient to hold corona within reasonable limits.

In an endeavor to ascertain the cause of line breaks, many samples of conductor, taken from the point of failure, were examined. Consulting metallurgists were called in to assist in determining possible causes. But although many explanations were advanced, isolation of a specific cause cannot be said to have been achieved.

One characteristic, however, was

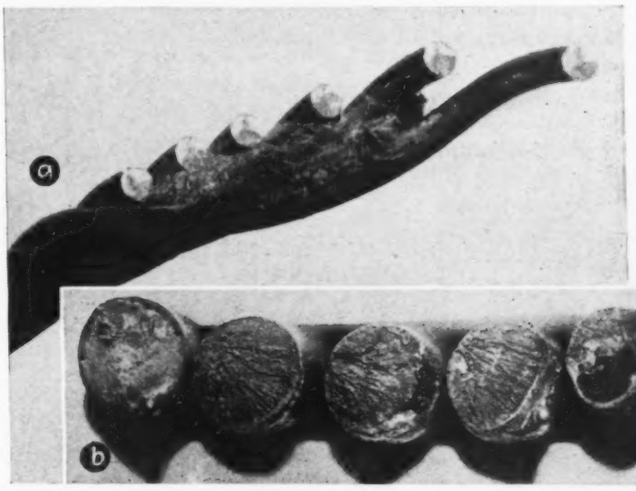


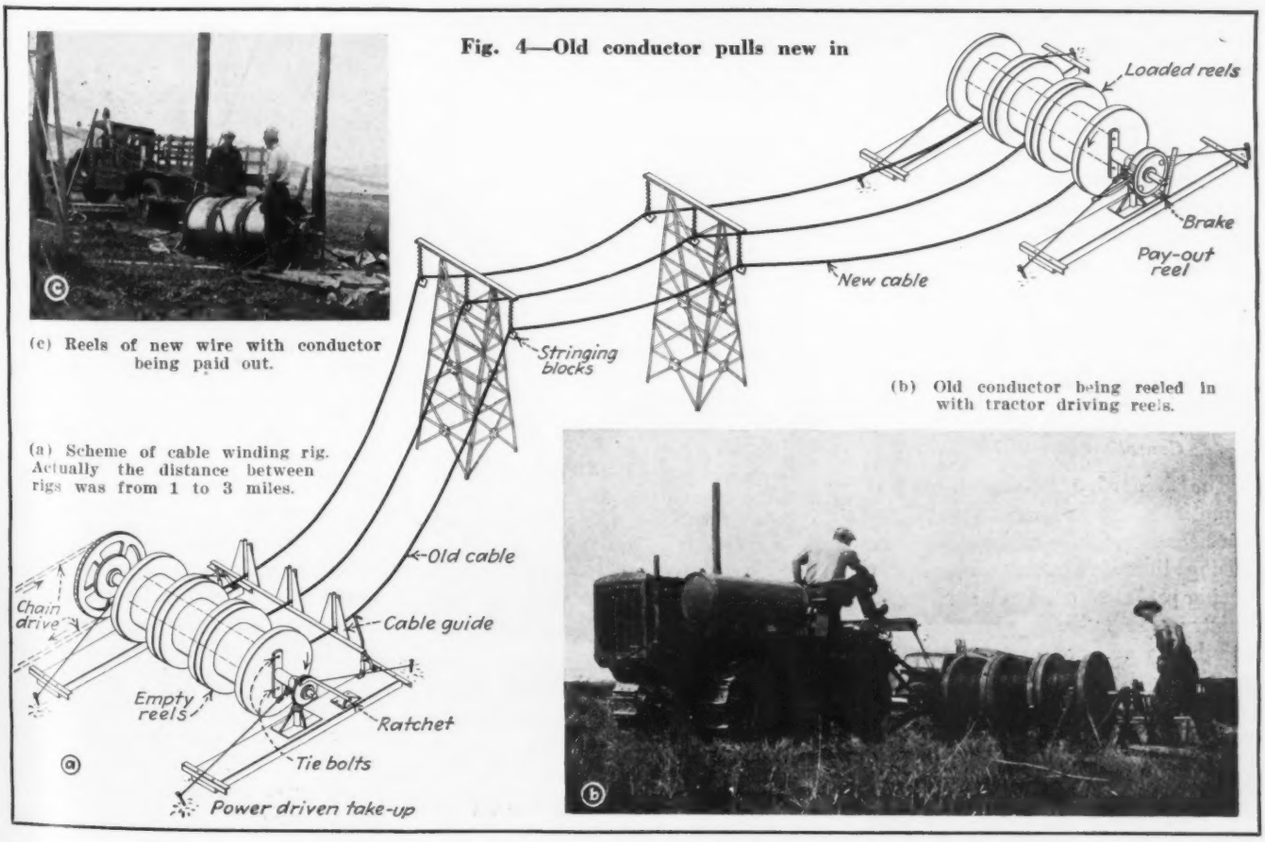
Fig. 3—Conductors failed with square break

(a) Point of failure showed square break and discoloring adjacent to hemp.

(b) End view of conductor strands at point of failure.

(c) Reels of new wire with conductor being paid out.

Fig. 4—Old conductor pulls new in



(a) Scheme of cable winding rig. Actually the distance between rigs was from 1 to 3 miles.

(b) Old conductor being reeled in with tractor driving reels.

observed in every case. This was the appearance of a dark spot at the conductor end, on the side adjacent to the hemp. In some cases this spot was small, in others it extended nearly across a strand (Fig. 3). All fractures were square breaks with practically no "necking down."

Principal explanations of failure were:

1. That corona discharge formed nitrates which, in the presence of moisture, formed chemical solutions which were absorbed by the hemp and subsequently corroded the wire.

2. That the combination of high oxide content in the copper, presence of carbon dioxide and probably sulphur and chloride in the atmosphere, and moisture in the hemp, worked together to effect corrosion.

3. That overdrawing of the copper had produced checks which admitted air and other agents.

Since the explanations were neither conclusive nor indicative of a specific remedy, it was decided to replace the conductor.

Having an important bearing on this job were the high altitudes with presence of corona and the fact that towers were of light construction which did not permit an increase in load. Thus No. 4/0 A.C.S.R. was selected for the majority of line and ½-in. Copperweld on the heavier towers at high altitudes. In these regions winds reach extremely high velocities and temperatures drop to 60 deg. below zero. High-strength insulators were used in conjunction with the Copperweld. Insulation was increased to seven units in suspension, eight at dead-ends. This was accomplished without increasing the distance of conductor from crossarm, it being found that if this dimension were increased clearances to tower bracing would decrease to the point of possible flashover.

Complications overcome

The job of reconductoring was complicated by two conditions: First, the necessity for energizing the line during lightning storms and daily during peaks, and, second, the rugged country, which made it practically impossible to pull conductor out on the ground.

To meet the first condition the first named of the authors conceived the idea of pulling in the new conductor by pulling the old one out, thus keeping conductor continuously available throughout the section being worked. He also conceived the idea of machines which would reel in the three old conductors simultaneously while the new ones were being unreeled at the other end of the section. These machines were successfully constructed according to the designs evident in Fig. 4.

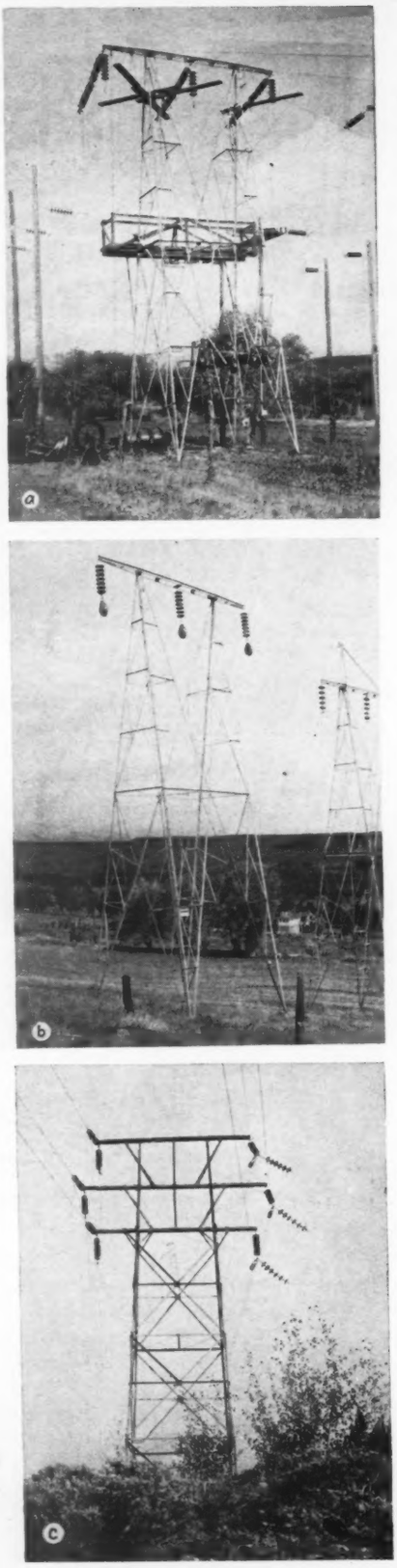


Fig. 5—Method of arranging for operations

(a) Dead-end tower with boards in place. (b) Conductor in stringing blocks at ends of new insulator strings. Old insulator arrangement on tower at right. (c) Dead-ends cut through on suspension insulator string. Conductor carried in stringing blocks on insulators.

Reels at the pulling end are carried on a solid shaft which passes through a hollow shaft, running in a bearing on top of the screw jack. Reels are tied by means of two tie-bolts passing through the reels and the plates on the ends of the hollow shaft. These serve to drive the reels, the shaft carrying dead load only. Drive is through a chain and sprocket from the power take-off on a tractor. A ratchet on the shaft at the end opposite the drive prevents unwinding should the chain break.

The pay-out rig is a similar arrangement of shafts on bearings and screw jacks, except that a break is substituted for driving power.

Preparing for the job

To start the job, boards were installed on dead-end towers (Fig. 5a) and the dead-ends cut out. The new strings were placed, carrying blocks instead of clamps (Figs. 5b and 5c) both for the stringing operation and for temporary return to service. As soon as the new conductor was pulled through, the middle wire was pulled up above tension, then eased back to proper position. Outside conductors were then leveled off with this.

Experience on 105 miles of the line, reconductored by this method, showed that it was practicable to pull in from 1 to 3 miles of conductor with a single set-up. Availability of a telephone circuit materially aided in the work.

For many reasons exact costs cannot be stated. Because of incidental work on insulator strings, towers, hardware, etc., it is difficult to isolate costs of reconductoring alone. But even were this possible, it has been our experience that because of the high, extremely rugged country, costs would appear high and would not be generally applicable to other systems.

It is, however, our definite belief that this method effected unusual savings both in dollars and in time. Furthermore, the job was completed without an injury, and with the line at all times available for service on short notice.

The Distribution Engineer and Utility Management

By LEWIS PAYNE *

President Eastern Shore Public Service Company, Salisbury, Md.

ULTIMATE objectives of management are (a) rendering adequate service economically, (b) making a profit for the stockholders, (c) maintenance of good public relations. These three objectives are so interrelated that each can be considered only in relation to the others. Good public relations, for instance, depends on adequate and economical service, and certainly profit is questionable if either good public relations or adequate, economical service is not to be had. Rendering adequate service economically, however, is dependent in the larger measure on the ability and work of the distribution engineer.

Before considering some of our present distribution problems it would be apropos to outline the *qualifications* of a distribution engineer:

A. He must be familiar with standards of materials and construction used for new work as well as rebuilding. He must be thoroughly familiar with all problems and economical methods of both operation and maintenance and know safety standards.

B. He must have knowledge of methods used in standard as well as special practices.

C. He must be thoroughly capable of computing line and system losses—resultant demands from diversified loads, etc.

D. He must be familiar with protective and control apparatus so as to apply such apparatus to his distribution system economically and to insure safe and continuous service.

E. He must be systematic in developing and maintaining maps and records of the distribution system.

F. He must by all means be temperamentally equipped to co-operate with others in order that the functions of the utility may operate both smoothly and economically.

These constitute the qualifications of a distribution engineer.

The *specific* work of a distribution engineer may be outlined as follows, and in this outline I shall endeavor to embody the principal problems that offer the greatest concern to the executive. There are five major categories.

A. Versatility, adaptability, ingenuity

In problems of designing and the resultant supervision of the construction of distribution systems, he must be able to adapt his ideas most economically and advantageously to fit the district to be served—good service and economical operation must result. A few years ago it was common practice to expect almost any well-designed and constructed distribution system to be good for at least a ten-year development period. The engineer is indeed good who has any such vision today.

He has the same old problems in determining load centers, proper selection of both primary and secondary voltage, consideration of whether the system is to be three or four wire, wye or delta, etc., recognizing that higher voltage permits the use of smaller wire, *but* these ideas were more or less commonplace when money was cheap. No longer does this condition exist, so Mr. Engineer must really get down to engineering. These same principles must yet be carried out, but mainly with what materials he may have on hand, and a step-by-step balance must be worked out progressively for each development or change in an existing system.

From an executive's viewpoint each dollar now invested or to be invested must earn from the beginning a greater return than was formerly expected. How? That is now the engineer's problem. However, as a reminder, the lower voltages can sometimes be doubled—2,300 to 4,600 volts, delta system can be wyed, existing system capacity may be frequently increased by the installation of pole type capacitors. Step regulators may be more advantageously used even in cascade. Problems in new design may involve such questions as cable vs. overhead wires, number and location of substations, and in rural lines the question of pole spacing in both rolling and flat country is not to be overlooked.

It is the writer's opinion that an individual line should be designed, and not just built to "Standard Specifications." In certain terrains it may be necessary to consider different types of line before the most economical can be determined—a cut-and-try method, so to speak. Certainly in any overhead distribution line, whether urban or rural, there will be some poles and structures that will carry heavier loads than others; naturally, the reverse of this statement is just as true; so why, when economy is at stake, should an engineer be content to use all poles of a given classification just because an old specification calls for it? This may be the easy way, but is it the right way? I do not believe so.

If greater economy is to be had new ideas must be developed. We hear a great deal of system planning, load forecasting, the development of primary and secondary networks; all have their place and should be fully considered, but only in relation to its direct application to the area to be served. Ingenuity is one of the characteristics that determines the qualifications of an individual; therefore, as I have previously said, new ideas must and will be developed for further economy.

B. New uses for prevailing materials

It is the specific work of the distribution engineer to work out new

* Paper presented at meeting of Southeastern Electric Exchange, Engineering and Operating Section, Richmond, Va., March 24, 1938.

applications for existing construction materials and methods of economical installations. On a property not so far from us a 6,900-volt overloaded system was recently stepped up for 22,000-volt operation. No new insulation was available—only an accumulation of pin-type insulators that had previously been removed from a 44-kv line. These were carefully tested and all that were good for 22-kv. operation were saved and used on this line. They may look slightly heavy and even funny to the operating staff, but the money saved looks pretty good to the executive. Another property by changing its former plan of handling meters on customers' premises avoided purchasing any new meters during the past eight months—a saving of several thousand dollars—this also looks good to the executive.

C. Alert to losses, wastes, savings

The specific work of the distribution engineer makes it necessary for him to make constant and even continuous tests to insure adequate service to his company's customers. Frequently very little concern is given either to the installation of a new transformer or to the replacement of a damaged one. Several hundred dollars is usually involved. Transformers are not cheap, nor is the equipment to protect them, but a ground rod is—costs about $1.50, I believe. How many of you require the value of this ground connection to be actually checked in every installation or change of a transformer? It is not expensive to do it and I can think of no greater saving than by minimizing our transformer losses during the lightning season, yet it has grown to be a habit to install a single ground rod for the transformer, regardless of either the nature of the soil or the value of the equipment to be protected.

In the design of a distribution system we place a great deal of importance on the anticipated losses; check after check is made. After it is in service should it not be just as important to check these losses systematically, to locate and isolate any rat holes, that they may be promptly plugged? I know of one case where a check was made on a small distribution system and one polyphase meter was found operating on the slow element; apparently it had been working as hard as any good soldier could with one side completely paralyzed since 1933. Constant and regular checks—voltage, power factor, watt-hour meters should be a religious requirement of every alert engineer. More and more attention is and should be given to the unaccounted-for energy. Peculiarities of individual systems partly explain a spread of from 10 to 30 per cent of the energy pumped into the distribution system which does not appear in revenue-producing kilowatt-hours.

Highly scientific operating technique of the power system manipulates individual generation efficiencies and system links so that losses from scheduling units are kept to a fraction of a per cent. But the alarming thing happens when these economies are then squandered in the far-flung distribution system. Naturally it should be the first concern of the distribution engineer to locate all of the components of loss and eradicate their causes as promptly as possible. He has many avenues in which to work; primary and secondary losses, transformer and regulator losses, meter losses as well as meter errors, errors both in reading and the result of improper connection and calibration; unauthorized diversion, and a number of other familiar channels.

The total investment in central station systems in the United States is more than twelve billion dollars. This is divided approximately as follows: Thirty-eight per cent in distribution, 32 per cent in transmission system, 30 per cent in generating stations. In the past ten years expenditures for additions to distribution systems have increased much more rapidly than expenditures for either generating or transmission systems. For this reason the executive again looks to the distribution engineer for new methods and additional ways to overcome the unreasonable losses and insure the greatest return on the lowest investment in distribution work.

D. Co-operation with load builders

It is the specific work of the distribution engineer to co-operate with the new-business department in securing new customers as well as retaining old ones. Hydraulic brakes of an improved type have been put on the utilities' ability to build and spend without *now* giving full consideration and regard to the soundness and stability of the load to be served. The net result is that we now have some lines and some entire sections of our distribution system that will not permit a further loading, yet other sections are able to supply additional loads economically. Therefore, the thought of selective selling or selective loading should be a co-ordinated duty of the distribution engineer and the commercial or merchandising manager.

Certainly an added return from an existing investment will be more appealing to any executive than a request for new money for either new extensions or for revamping an existing feeder. Selective selling must be based on a prior investigation and study of the distribution system in question. With this information in hand, however, it is entirely possible and practical to select a type of equipment or appliance that will more nearly fill in with the load-building plans. Each area or possibly each feeder, however, offers a study within itself. Ranges may be permitted in the area on Front Street; however, lack of capacity on Back Street limits the load-building activities to off-peak application only.

Within the past few years air conditioning has entered the distribution field and has brought with it many perplexing problems. We now have a new device which promises to be so popular that at every crossroad store we may find a familiar sign advertising "Frozen Vegetables for Sale." With the ever-increasing popularity of this product and with the ability of the commercial refrigerator redesigned to handle properly the frozen foods we may expect an increased sale for the equivalent of small refrigerators. This load will likely be an annual one rather than the seasonal load of air conditioning.

As a further reminder the home ventilating system which operates at night only will also offer you an off-peak load in addition to the water heater, which may prove beneficial in filling the summer nocturnal valleys at least. Again, selective loading depends directly on customers' analysis; opinions even frequently supported by individual transformer

[*Continued on page* 132]

Instruments Register Strains in Bonneville Dam Concrete

By CLYDE ROBINSON . . . GEORGE BORKOWSKI
Bonneville, Ore.

SOME 285 electrical test instruments are being used to measure stress, strain and temperature in the Bonneville Dam on the Columbia River. Each instrument is embedded separately in concrete or bedrock and measurements are made from a central terminal panel. Entirely new data are being accumulated, making a valuable addition to the present knowledge of the behavior of mass concrete.

The dam itself, being built by the U.S. Engineers, is 40 miles east of Portland, Ore., at a point where Bradford Island splits the Columbia into two channels. The main channel, about 1,200 ft. wide, is blocked by the spillway dam which contains the test instruments. In the smaller channel between Bradford Island and the Oregon shore are the power house and the ship canal and lock. The main or spillway dam is of the gravity type and rests on a foundation of Eagle Creek bedrock, which is a conglomerate of rocks and gravel cemented together with finer material.

In general, instruments were placed where calculations showed that points of maximum stress would occur. In addition they were placed in representative areas so that information on conditions of temperature and strain throughout that section would be available. A few special installations were made also where peculiar conditions made unusual strains probable; for example, where a portion of the foundation was underlaid by a clay seam.

Thermometers and strain-measuring devices

Instruments in use at Bonneville are of three general types—thermometers, strain-measuring devices and stress-measuring devices. The strain-measuring devices may be subdivided into three classes, according to their range of movement; however, the principle of operation is the same. The instruments were all developed by Roy W. Carlson, civil engineer at Massachusetts Institute of Technology, and some of the first ones in this installation were placed under his direction.

Thermometers are of the simple resistance type, containing a coil of copper wire resistance of which changes with temperature. The coil is insulated and placed in a brass cylinder about ¾ in. in diameter and 4½ in. long, sealed to prevent the entrance of moisture. Temperature is obtained from resistance measurements made with a Wheatstone bridge. Only the actual coil resistance is used, the lead resistance, which in some instances is considerable, being eliminated by the use of a third wire.

Three classes of strain-measuring devices are, in order of increasing range, strainmeters, jointmeters and foundation meters. The approximate ranges of the above instruments (that is, the total movements for which they are designed) are

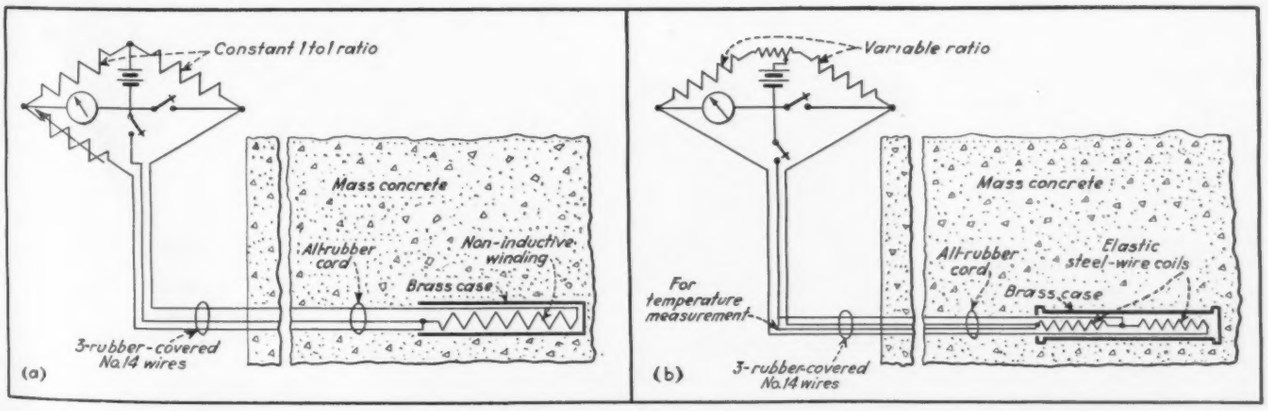


Fig. 1—Wheatstone bridge principle for both (a) temperature and (b) strain measurements

Measurements of strain, stress, movement and temperature are all made with one device, the Carlson test set. It is a modified form of the Wheatstone bridge, having a constant ratio of 1:1 and sufficient built-in resistance to measure values from 0.01 ohm to 111 ohms, readable to 0.01 ohm.

Either total resistance between binding posts or the coil resistance of an instrument (total resistance minus lead resistance) may be measured. To obtain temperature the coil resistance only is used (a). For this connection three leads are employed. One in effect is the battery lead; the two others are each a part of one of the arms of the bridge and balance each other out, providing they are of equal resistance. Leads about 1,000 ft. long are being used successfully.

In measuring resistance ratio the two coils in the test instrument (plus their leads) are used as two arms of a Wheatstone bridge circuit, the other two arms being contained in the Carlson test set. Ratios can be read directly from the set with an accuracy of 0.01 per cent over a range of 5 per cent above or below unity.

0.02, 0.2 and 0.5 in., respectively. Since their operation is similar only the strainmeter will be discussed.

All materials change their electrical resistance when either the temperature or the stress is changed. In a metal the conduction of an electric current is mainly by free electrons, and as the metal is compressed the electrons are believed to be more free than before, resulting in a decreased resistance. Tension produces an opposite effect. The Carlson strainmeter takes advantage of the linear relation between electrical resistance and stress in steel by an ingenious arrangement whereby the resistances of two coils of steel music wire are changed in opposite directions by a given change in length of the instrument. The change of resistance ratio of the two coils is proportional to the change in length of the instrument, within its range, and it may therefore be calibrated in inches per unit change of resistance ration. A modified Wheatstone bridge circuit (Fig. 1b) is used to measure the ratio directly.

The strainmeters (Fig. 2) at Bonneville are inclosed in a cylindrical brass case 10 in. long by about 1¼ in. in diameter, and three lead wires are brought out.

Jointmeter and foundation meters had similar dimensions and construction, the chief differences being that the coil resistances were lower and the range of movement greater.

The stressmeter differs from the strain-measuring devices in that it measures compressive stress in the concrete in pounds per square inch and is almost independent of volume changes due to causes other than stress.

It consists of a steel plate 8 in. in diameter and ½ in. thick with a strain-measuring unit protruding from the center of one face. The plate is actually a mercury-filled diaphragm, the mercury pressure causing a deformation of the strainmeter unit which is proportional to the stress acting on the plate. Three leads are brought out as before, but by the addition of a fourth lead the instrument can be used to measure temperature.

Installation made in concrete

Thermometers, strainmeters and stressmeters were installed simply by placing them in fresh concrete in their proper locations and tamping the concrete gently around them. Three-conductor or four-conductor rubber-covered cable (as the case might be) was led across the block to the upstream inspection gallery, and from this point No. 14 solid rubber-covered wire led to the terminal panels.

Jointmeters were placed across contraction joints between blocks, which were never poured simultaneously to the same level; therefore a recess had to be made in the high block and the jointmeter installed when the low block was poured to that level. At times the leads had to be run in the higher block; on such occasions the joint-meter was placed inside the recess form with sufficient slack cable to allow later installation in the proper position across the joint.

"Rosette" groups (Fig. 3) consisting of one stressmeter and three strainmeters set at different angles were installed in six locations. These were placed under a pier at points of maximum stress so that theoretical stresses and strains in several planes could be checked against actual measurements.

It was desired to measure the total deformation or settlement of the foundation of the dam over depths varying from 5 to 30 ft. below the first lift of concrete, and to do this the foundation meter installation was designed.

The meter was attached to one end of a ¾-in. pipe which extended through a 2½ in. casing into bedrock and was grouted into the rock at the bottom of the hole. A U-shaped frame was set over the top of the meter and bolted to the rock or concrete on either side so that as the foundation was compressed the meter was compressed a like amount between the U-frame and the top of the pipe. In effect the gage length of the meter was increased from its original 10 in. to the desired length of 5, 15, or 30 ft. Since temperature changes had an appreciable effect on so long a pipe, thermometers were placed at 15-ft. intervals inside the ¾-in. pipe, and a fourth wire was added to each foundation meter

[*Continued on page* 134]

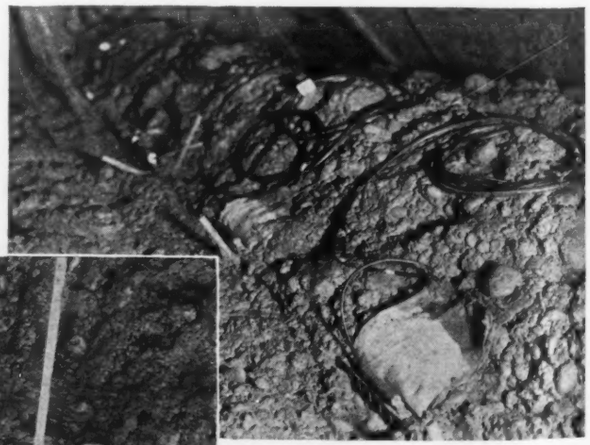


Fig. 3—Rosette groups consisted of three strainmeters and one stressmeter

Fig. 4—Strainmeters were mounted here along a steel reinforcing bar, eight placed across a block, the ends of the bar being buried in adjacent blocks

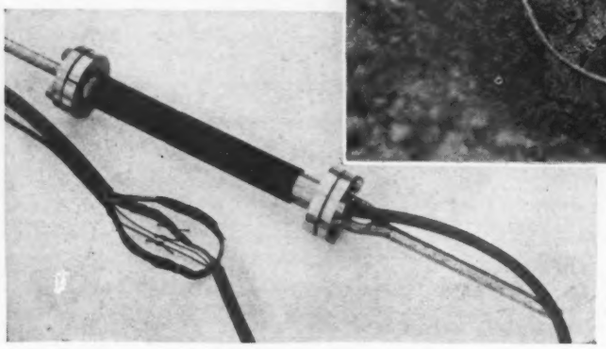


Fig. 2—Strainmeter with extension rods for special installations

One lead is connected to the junction of the two coils, while the other two are connected to the two ends. The steel coils are immersed in acid-free castor oil so as to protect them from corrosion and oxidation. A bellows section in the case allows longitudinal movement considerably greater than the range of the instrument, and an expansion chamber filled with inert gas reduces internal pressure changes. Where a fourth lead was added to obtain temperature measurements it was connected to one of the wires leading to the end of a coil, the splice being made within 3 ft. of the instrument.

Wisconsin Diesel Plants Show Better Results

Two-Year Improvement in Business Gave Better Loads and Consequent Better Operating Conditions

COMPARING record data for the two years 1934 and 1936, it appears that eleven Wisconsin municipalities have reduced the average cost of energy sold from 2.76 to 2.32 cents per kilowatt-hour and the revenue from 3.72 to 2.95 per kilowatt-hour. This comparison arises from reports by Jay Samuel Hartt, consulting engineer, Madison, Wis., lately appointed trustee for Utilities Power & Light Corporation. The first of Mr. Hartt's reports, covering years up to and including 1934, was abstracted at considerable length in ELECTRICAL WORLD, December 12, 1934, and the second, of operating results for 1935 and 1936, has recently been released. The plants covered by the reports are all with Diesel engine generation, although in a few cases small amounts of energy are purchased or produced by steam or hydro power. Direct comparison of detail figures for each of the eleven towns may be made between the accompanying table and one in the same form in the previous publication.

Other comparisons between total figures of the previous and present reports are:

	1934	1936
Diesel plant investment	$993,068	$1,068,421
Total Diesel horsepower	9,950	11,705
Average investment per horsepower	$99	$110
Total fixed capital	$1,981,490	$2,146,501
Energy generated and purchased (kw.-hr.)	13,751,989	17,535,624
Energy accounted for (kw.-hr.)	12,066,128	15,786,546
Losses (per cent)	12.2	10.1
Number of customers	9,163	9,122
Average kw.-hr. sales per customer	1,318	1,732

Another condition, incapable of expression in total or average figures, is that of adequacy of generating capacity. It was shown in the first report that nine out of the eleven systems had installed capacity inadequate for reliable service in consideration of the peak loads imposed on them. In spite of the increase in total horsepower shown by the figures above, this condition has not been remedied in any case. The report for 1935-1936 shows the same nine towns still taking the same gamble—that the largest unit in the plant will not fail or be out of commission at the time of peak load.

The average kilowatt-hour sales per customer, shown above, include all customers, and for that reason may not be taken wholly or in any great part as an indication of domestic load building. Rather, the large increase of more than 400 kw.-hr. in two years suggests that it is the result of generally improved business conditions causing greater commercial and industrial activity. However, the increase in average use is significant in that it explains the reductions in total cost and revenue per kilowatt-hour by consequent more efficient utilization of the various system facilities.

The increase in Diesel plant investment of $75,352, compared with the increase of $165,011 in total fixed capital, very probably indicates these eleven municipal systems found on their hands the same problem that faces all electric utilities, the need for improvement of means for getting the service to the users.

Operating Results of Eleven Wisconsin Municipal Diesel Plants for 1936

	Revenue, Dollars				Operating Expenses (Total Dollars; Cents per Kw.-Hr. Sold)																Operating Income	
	Total	Per Kw.-Hr. Sold	Per Customer	Per Dollar of Distribution Investment	Production* Diesel Hydro and Steam		Distribution†		Utilization		Commercial		General and Miscellaneous		Depreciation		Taxes		Total Expenses		(Dollars)	(Per Cent Investment)
Arcadia	24,704	0.039	43.70	0.442	8,814	1.39	229	0.00	387	0.06	1,063	0.17	1,940	0.31	6,208	0.98	1,807	0.28	20,448	3.23	5,295	4.2
Argyle	12,845	0.0529	46.10	0.738	5,257	2.24	454	0.19	224	0.1	211	0.1	397	0.17	1,996	0.85	730	0.31	9,269	3.96	4,177	6.2
Barron	42,074	0.0288	65.50	0.866	11,822	0.81	6,176	0.42	199	0.01	1,284	0.09	1,132	0.08	12,270	0.84	5,748	0.39	38,631	2.64	3,866	1.6
Cashton	11,591	0.0412	45.10	0.721	4,589	1.63	245	0.09	66	0.02	108	0.04	576	0.21	2,777	0.98	846	0.3	9,207	3.27	2,991	5.7
Cedarburg	55,576	0.0404	66.30	0.602	21,621	1.57	1,918	0.14	834	0.06	1,132	0.08	2,158	0.16	10,800	0.78	2,992	0.22	41,455	3.01	17,116	7.2
Elroy	25,494	0.0478	48.00	0.752	7,777	1.45	2,062	0.39	335	0.06	389	0.07	2,396	0.45	4,509	0.84	1,482	0.28	18,950	3.54	7,447	8.3
Kewaunee	34,417	0.0396	43.20	0.475	13,287	1.53	414	0.05	622	0.07	1,538	0.18	1,199	0.14	9,357	1.07	2,446	0.28	28,863	3.32	8,223	5.4
Lake Mills	44,707	0.0263	46.90	0.490	16,288	0.96	2,660	0.16	556	0.03	808	0.05	2,687	0.16	9,464	0.56	1,353	0.08	33,816	2.00	10,363	4.0
Menasha	145,471	0.0214	50.20	0.519	55,891	0.82	11,369	0.17	2,074	0.03	2,689	0.04	7,553	0.11	24,471	0.36	14,255	0.21	118,302	1.74	35,971	5.9
New Lisbon	19,032	0.0412	52.10	0.749	7,462	1.61	573	0.12	760	0.16	205	0.04	1,737	0.38	1,290	0.28	500	0.11	12,527	2.70	7,505	9.9
River Falls	49,221	0.0347	50.40	0.716	10,298	0.73	4,586	0.32	1,351	0.10	2,808	0.20	1,681	0.12	10,057	0.71	4,127	0.29	34,808	2.47	13,813	6.2
Total or Weighted Average	464,965	0.0295	51.10	0.578	163,106	1.03	30,686	0.19	7,408	0.05	12,235	0.08	23,456	0.15	93,199	0.59	36,286	0.23	366,376	2.32	116,767	5.4

*Includes production costs transferred to water department for energy consumed there; also includes energy purchased in the case of Kewaunee.
†Includes transmission and conversion in some instances.

Series Capacitor Regulates Furnace Power Factor

By R. E. MARBURY . . . C.C. LEVY
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USE of capacitors in series with the load to compensate for circuit reactance is less well known than the use of shunt capacitors on power circuits to compensate for the wattless kva. taken by the load and thus relieve the line from handling this excess magnetizing current. During the last few years, however, the use of series capacitors has greatly increased. Recent advances in the art of making capacitors has resulted in the lowering of cost, weight and size, and improvement in performance in general. Consequently the interest in this type of capacitor application has greatly increased.

Reduction in voltage drop in the circuit may be brought about by the use of series capacitors controlling the reactive drop directly. This benefit becomes more noticeable when the dominating load is of poor power factor. Suddenly applied loads cause lamp flicker, which cannot be prevented by voltage compensating devices which are not instantaneous in response. Since the compensating effect of the series capacitor takes place instantaneously, it is usually applied for the purpose of improving instantaneous regulation, on circuits where trouble is being encountered due to lamp flicker.

Construction of series capacitor units is no different from shunt capacitors; the difference lies in the application and control details. Voltage across a shunt capacitor is fixed by the circuit voltage and is relatively constant. The user is primarily interested in this case in the leading reactive kva. which will be drawn by the capacitor, and the relation of this reactive kva. to the lagging reactive kva. of the load. It is, therefore, more applicable to conditions where the corrective kva. required is relatively constant.

When a capacitor is connected in series with the circuit, the voltage drop across the capacitor is a function of the current flowing in the circuit and may vary from zero, for the case of no load conditions, to some high value, such as would exist under short-circuit conditions. Since the size and cost of the capacitor varies as the square of the maximum voltage for which it is insulated, it is necessary either to design the capacitor to withstand the voltage which would be developed under short circuit or limit the voltage across the capacitor to some value slightly above the voltage corresponding to normal operating or rated current.

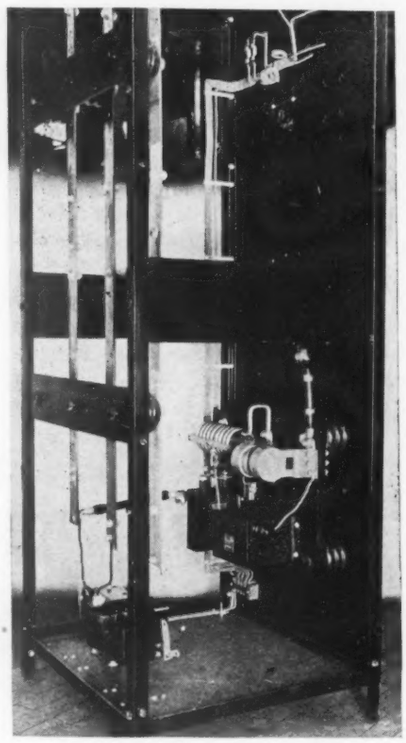


Fig. 1—Potential transformer and gap control panel protect against overvoltage surges

Carbon gap once broken down due to overvoltage on the capacitor holds voltage to low value and prevents building up of recovery voltage. Inasmuch as the gap once broken down will continue to arc, it is necessary to provide some means of either opening the circuit temporarily, using the gap current as a means of tripping, or short circuiting the carbon gap by means of a contactor, so as to terminate the arcing of the gap. When the line is energized again, or the contactor is again opened, the gap will not arc if the voltage across the capacitor is normal.

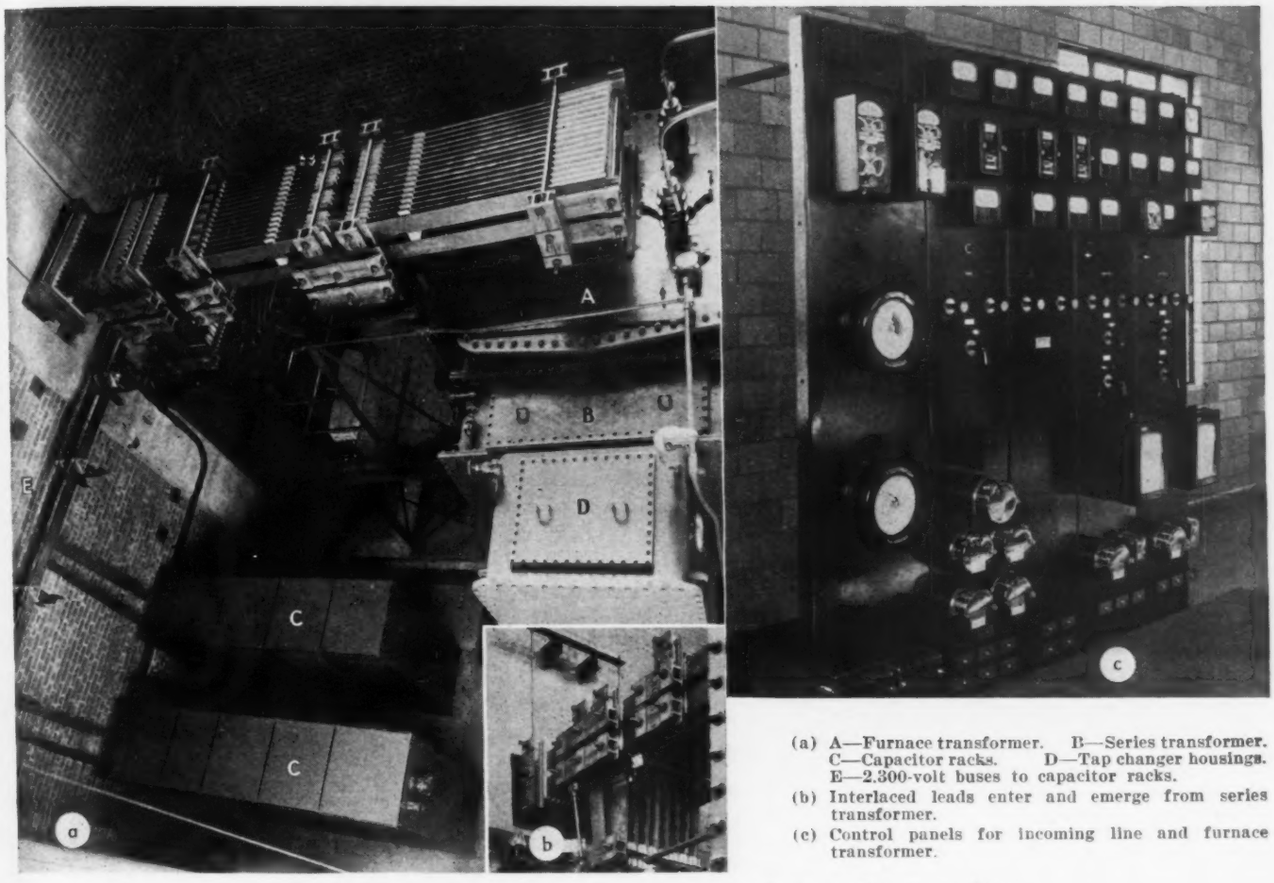
The voltage may be limited across the series capacitor by means of spark gaps, but the use of special carbon gaps having large thermal capacity and low arc drop is better for the requirements, because after the first operation of the gap it becomes ionized, and thereafter the voltage drop across it is quite low, and there is no tendency for high oscillating currents in the circuit formed by the capacitor and gap.

Standard capacitors adaptable

In most cost power circuit applications the voltage across the series capacitor is of the order of 400 to 600 volts, making it possible to use standard or near standard capacitor units. In some applications, however, the voltage drop across the series capacitor is much lower.

For example, a case where the series capacitor must have 1-ohm capacitor reactance for a line current of 100 amp. This means that the voltage drop across the capacitor is 100 volts. In this case 230-volt capacitors would have to be used for operation on 100 volts. This greatly increases the cost of the capacitor bank because of the uneconomic use of material.

A 7½-kva., 230-volt capacitor unit operates at 1.42 kva. when used on 100 volts, consequently the cost per kva. is multiplied by 5.2. One solution of this case is to use a series transformer to step up the voltage to a more economic capacitor voltage. For example, in this case a transformer having a ratio of 100 to 2,300 volts could be used and the 100-volt winding could be connected in series with the



(a) A—Furnace transformer. B—Series transformer. C—Capacitor racks. D—Tap changer housings. E—2,300-volt buses to capacitor racks.
(b) Interlaced leads enter and emerge from series transformer.
(c) Control panels for incoming line and furnace transformer.

Fig. 2—Series capacitor and transformer installation for resistor type furnace

circuit and a capacitor of proper characteristics, rated at 2,300 volts, connected across the 2,300-volt winding. The value of the capacitor would be such as to give the equivalent of 1-ohm capacity reactance in terms of the 100-volt winding.

When a capacitor is connected in the circuit through a series transformer it is necessary to give careful consideration to the saturation curve of the transformer. This usually means that the transformer must be worked at sufficiently low iron density so that saturation will not be approached within the working limits of the protective control. If saturation occurs, the equivalent ohmic value of the combination of series transformer and capacitor may change as a result of a sudden momentary inrush of current, and may not return to the original value unless the current is reduced to a very low value and brought up again.

This condition of instability is greatly accentuated when the voltage of the circuit is large compared to the voltage across the series capacitor. If the voltage across the series capacitor is larger than the supply voltage, the circuit is inherently stable. On circuits where the transformer connected capacitor operation is unstable due to the combination of circuit constants, it is possible to provide satisfactory operation by the use of the shunting gap and the short-circuiting contactors when the current in the circuit exceeds the critical value.

Correction of circuit reactance in large resistor type furnaces

Large single-phase resistor furnaces, which require currents of 30,000 to 40,000 amp., have hitherto been operated only from 25-cycle power. When 60-cycle power has been used the furnaces in the past have been made much smaller, requiring only 10,000 or 12,000 amp. This is due to the inherently high value of inductive reactance in the circuit of such furnaces, even when great care is used to reduce this reactance by interlacing the copper connections. When, therefore, conditions make it necessary to operate a large furnace on 60-cycle power a method of neutralizing the inductive reactance has to be worked out in order to avoid the penalty of low power factor operation with a correspondingly high power rate and large supply transformers. When the load resistance in such furnaces at the start of the run is considerably higher than at the finish, the voltage supply from the transformer must be varied throughout the run to maintain the desired load and heating in the charge. The adjustment in voltage can be obtained either by a load type tap changer with extended winding in the primary of the transformer or by a combination of the tap changer with series parallel switching on the low-tension side.

Under the conditions, when a furnace circuit requires 40,000 amp. the voltage drop across the resistance of the furnace might be about 40 volts, but the reactive drop in the circuit might be as much as 80 volts. To supply this load with such a high circuit drop in proportion to load drop would result in an over-all power factor of approximately 44 per cent and a very substantial increase in the kva. rating of the main supply transformer.

Furthermore, the reactive voltage drop varies with the current, being a direct result of the relatively fixed reactance of the circuit and varying operating currents.

Two methods of attacking the problem can be considered. The first and most obvious one is to correct the power factor on the high-

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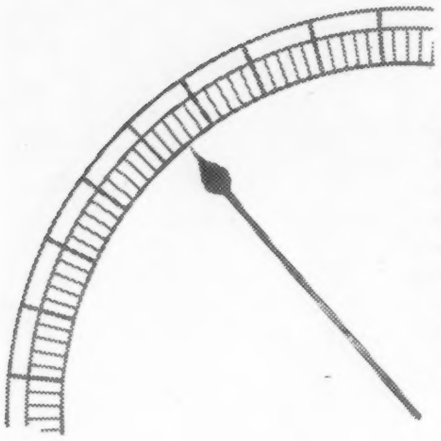
INSTRUMENTATION



When You Measure You Know

Efficiency, economy, good service are the purpose—and the result—of the wide-scope instrumentation of electric utilities

A SYMPOSIUM CONDUCTED BY

A. E. KNOWLTON
Associate Editor, ELECTRICAL WORLD

SOME ONE has aptly said, "Labor is not something people are, labor is something people do." Nor is the use of instruments in the utility industry an end in itself—it is the means to an end. That objective is the securing of measurable information which becomes the indispensable facts on which the utilities conduct their operations all the way from coal pile to consumer. The common conclusion of all the following articles, written expressly for this ELECTRICAL WORLD symposium by recognized authorities, is that use of instruments on a comprehensive scale is one of the very big factors in the ability of the industry to make better service available to users at steadily lowered prices.

More instruments—in number and in variety—are used in the electric power industry than in any other that can be named. One ready reason is that electrical quantities and properties are conveniently measurable. A far better reason is that the information the instruments provide is worth many times more than the cost incurred to obtain the information. If it were not so the authors of the accompanying articles, embracing the whole gamut of utility operations, could have told their convictions in less confident and persuasive portrayal. As it is, each author seems to assume that his readers will take it for granted that every instrument mentioned represents a fully justified expenditure. Economic proof is superfluous.

The utilities *could* estimate what their customers consume. They *could* count carloads of coal, let bushings and windings fail and replace them; they *could* make a good engineering guess at steaming rates, turbine bearing currents, feeder voltage drops, flicker effects from starting currents, progressive deterioration of insulation, industrial plant power factor, diversities of range loadings, and even the interchanges over interconnection lines. All these things are, however, *measured* either continuously or periodically in the well-administered properties.

As a result the power industry is fortified with accurate data. Knowing the facts and the trends from tests and reliable instrument indications, the industry has acted on them to improve economy of generation and distribution; to avert losses of energy and occurrence of operating failures, and to induce the loads most advantageous for its patrons and itself. Wherever the instrumental equipment is restricted in scope it is likely often to be the case that management is wavering on some consideration merely because readily measured facts are lacking to support a positive decision.

Productive industry should scrutinize the extensive use of instruments by the power companies. Out of such a study might well come a realization that frequent or even continuous electrical input measurements around the productive plant would afford a key to operating wastes and avoidable losses that would pay for the measuring equipment in short order. In fact, there already are signs that the next stage in organization for volume production will center around a dispatching and control board where the production manager will be able to observe instantly every departure from scheduled performance and arrange the corrective at once. Avoiding the delay that would ensue from studying work records whole days later would render industry comparable to the utility dispatching board with meters for every load and station and instant action toward maximum economy. With that move is sure to come the adoption of a wide range of isolated instrumentation approaching in degree the comprehensiveness with which the utilities are here shown to have equipped themselves to mutual advantage of their patrons and themselves.

By
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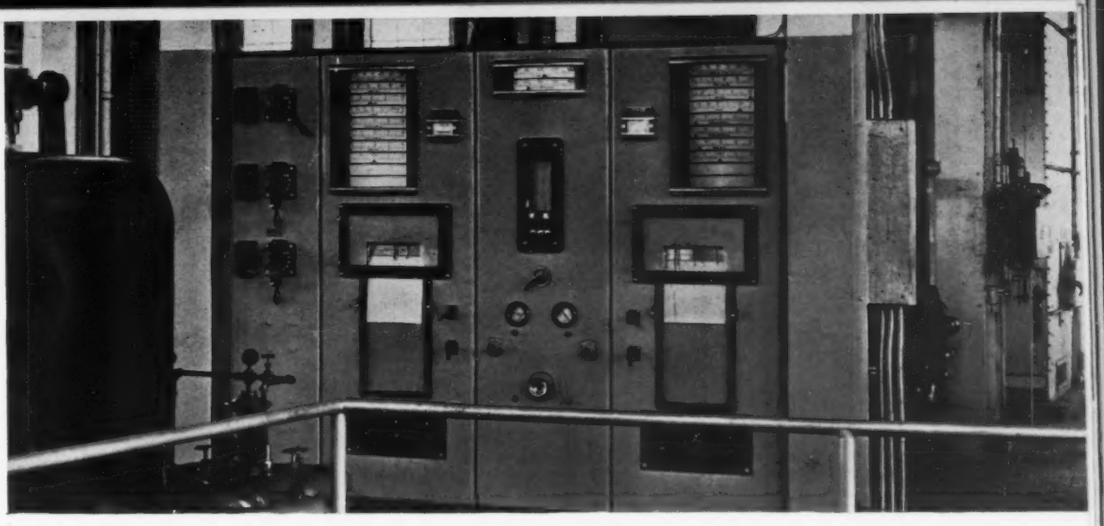
Sargent & Lundy, Inc., Chicago



Metering Controls Economy in the Power Plant

BEGINNING with the raw material as coal or some other fuel, through its conversion into thermal, then mechanical and finally electric energy, the processes of electricity production in a steam power plant require exact control for efficient operation. The requirements of immediate control—that is, the maintenance of proper conditions of operation—are filled by indicating instruments of many various kinds, ranging from indications of heat and gas conditions in the furnaces to power factor of electricity output. But to maintain proper operating conditions it is necessary first to establish them in terms applying to the particular requirements of time and place. This is done by the use of recording and integrating instruments that measure quantities of fuel, water, heat and electricity.

In order to show the variations of metering applications in different types and sizes of steam power plants the details of instrumentation in three plants that may be considered as typical are presented here. There is the large unit, represented by State Line station of the Chicago District Electric Generating Corporation. This is a 150,000-kw. machine, with tandem turbine cylinders, taking steam at 1,200 lb. and 825 deg. F. from two boilers each of 500,000 lb. of steam per hour rating, fired with pulverized coal. Another boiler reheats the steam between the high- and low-pressure cylinders.

The second instance is of a topping turbine installed at the Fisk station of the Commonwealth Edison Company. This is a 30,000-kw. machine taking steam at 1,200 lb. and 900 deg. F. and exhausting into a header from which any two of three 200-lb. turbines may be served. The third case illustrates the small size, simply designed plant. This is a 5,000-kw. unit installed in the Woodcock plant of the Central Ohio Light & Power Company at Bluffton, Ohio. Steam is supplied to the turbine at 425 lb., 825 deg. F.

Examination of the diagrams of instrumentation and accompanying explanatory reference lists of these three instances will show that the differences between them are of numbers of meters and of degrees of refinement in keeping track of quantities and conditions. In each case the general scheme of metering is the same as in the others. Which shows, of course, that the art of power plant metering has been pretty well established by development and invention in recent years.

State Line station

1. *Coal Cycle*—Coal is first weighed (Fig. 1) on track scales before the car is dumped. Then, after dumping, the empty car is weighed to obtain the difference which is the actual weight of coal being conveyed to the boiler bunkers. This weight is used for computing the coal consumed for the station efficiency records. The coal is weighed once more on scales just above each pulverizer. This weight is used for calculating the mill performance only.

2. *Feedwater Cycle*—Feedwater is first metered at the hotwell pump discharge, which includes the steam condensed from the turbine and also the makeup water from the hot water reservoir. All extracted steam for the heaters and evaporator plus the evaporated water is metered before being pumped back into the condensate system by drain pumps. Flowmeters are installed as an aid in checking the efficiency of the individual heaters. Flow meters are also installed on the discharge of each of the three high-pressure boiler feed pumps in order to check continually the capacity of each pump and, as well, on each of the three boiler inlets and outlets. These feedwater flowmeters are used for computing the station water rate, the boiler room efficiency and to check the steam flow meters.

3. *Pressures and Temperatures*—Temperature and pressure gauges are installed on equipment such as pumps, heaters, turbines, condensers, boilers, etc., so that the equipment is operated both efficiently and safely. Important records, such as superheated and main steam temperatures, steam and air flow, feedwater flow and temperature to each boiler, boiler drum level, air temperature to and from air heater, throttle steam temperature, reheat steam temperature and pressure, are all recorded on 24-hour charts that are permanently filed at the station. Test wells are provided around the heaters in the main condensate pipe, drain pipes and the extracted steam pipe for checking the efficiency of each heater. Indicating instruments with alarms are used for showing the temperature, pressure and purity of the hydrogen for cooling the generator.

4. *Electrical Meters*—Integrating instruments are installed for metering the energy production, sendout and uses in the station. Power factor, load and temperatures of the generator stator and rotor are shown on indicating meters.

Fisk station

1. *Coal Cycle*—Coal is weighed on scales (Fig. 2) just above the pulverizers. This weight is used for calculating the efficiency records and also for checking operating efficiency of the individual pulverizers.

2. *Feedwater Cycle*—Feedwater from low-pressure turbine hotwells is metered before being pumped to high-pressure unit. Raw water to evaporators is measured for a check on the evaporator efficiency

and also for a record of make-up water to the system. A flowmeter measures the steam from high-pressure turbine exhaust to low-pressure turbine throttles. On the discharge side of each high-pressure boiler feed pump the flow is measured as a check on the capacity of each pump. Recirculating lines on these pump discharges are used at low loads and have orifice plates inserted in the pipes so that this flow may be measured. The next metering of the feedwater is at the boilers and is used for checking efficiency of the boiler as well as high-pressure boiler room efficiency. Steam flow is metered at each of the boiler outlets to check the flow meter on the feedwater and also to show the steam flow to the turbine. Steam for the boiler feed pump turbines is metered to check efficiency of the turbines and also to show how much high-pressure steam is used by them. From these two flowmeters the water rate of the turbine may be determined.

3. *Pressures and Temperatures*—Pressure and temperature instruments are installed on most equipment so that it may be operated not only efficiently but safely. Most of these instruments are indicating, but the important readings that keep varying slightly, such as steam and air flow, drum level, feedwater flow, and temperature, main steam temperature, are all taken on recording as well as indicating instruments. These charts are used for calculating efficiency of the entire unit. The kw. output from the generator is metered, as well as the auxiliary power, to determine the net output of the unit. Indicators for the power factor, turbine speed, rotor and stator temperatures are also installed.

Woodcock station

1. *Coal Cycle*—Coal is weighed on scales before entering the pulverizers (Fig. 3) and this weight is used for calculating the efficiency records as well as for checking the individual mill performance.

2. *Feedwater Cycle*—Condensate water from the condenser is metered at the hotwell pump discharge. Water to the evaporator is metered so that a record of make-up water is available. From the use of heat balances the efficiency of the heaters is calculated, also the amount of steam extracted from the turbine. Meters are installed on the steam outlet of each boiler and are used for calculating the station water rate, boiler room efficiency and for checking the individual boiler performance.

3. *Temperatures and Pressures*—Instruments are installed on major equipment such as pumps, heaters, evaporators, etc., in order to operate the equipment efficiently and safely. Daily 24-hour records on important readings such as feedwater temperature, steam flow and temperature are kept in the station files.

4. *Electrical Instruments*—Watt-hour meters are installed on generator output and station auxiliary consumption. From these readings net energy output of the station is calculated. Instruments are also used for showing power factor, winding temperature and generator speed.

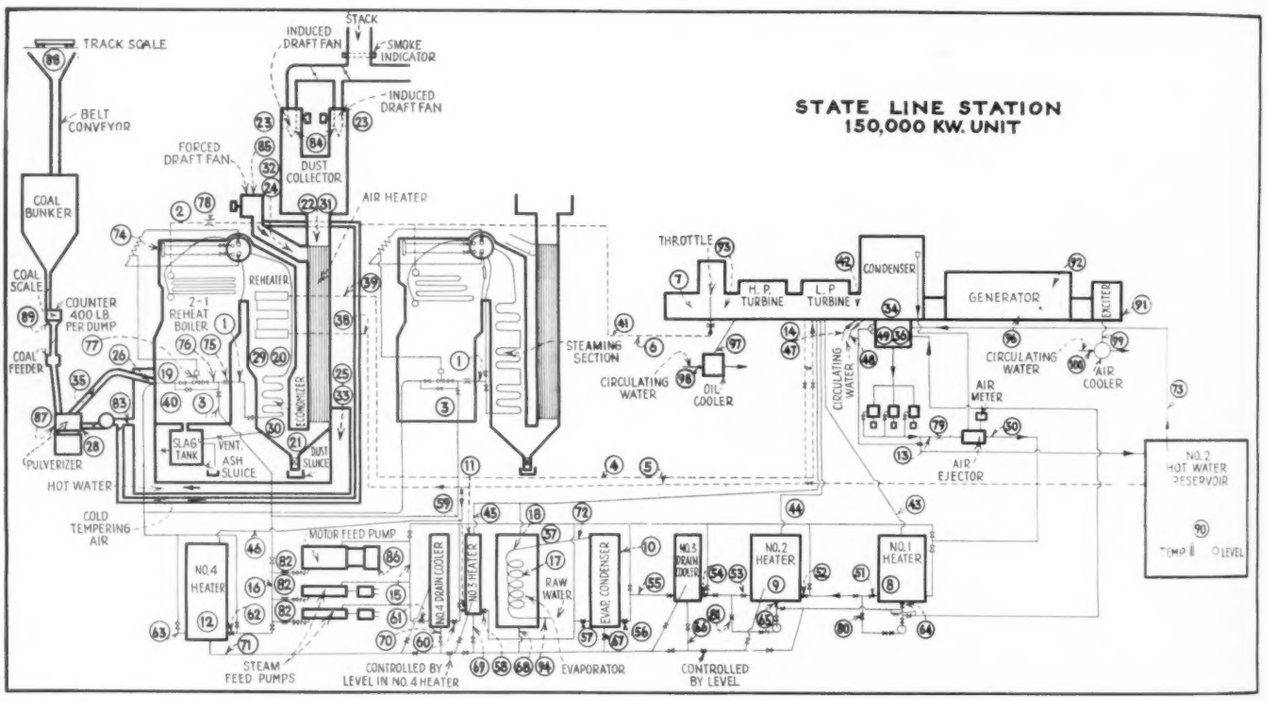


Fig. 1—State Line station instrumentation

1. Boiler feed pressure.
2. Main steam pressure.
3. Auxiliary feed pressure.
4, 5. Steam pressure to and from reheater.
6. Throttle steam pressure.
7. Primary, secondary, tertiary admission pressures.
8, 9. Heater Nos. 1 and 2 shell pressure.
10. Evaporator condenser shell pressure.
11, 12. Heaters Nos. 3 and 4 shell pressure.
13. Condensate pressure.
14. Circulating water pressure.
15, 16. H.P. feedwater pump suction and discharge.
17, 18. Evaporator shell and coil pressure.
19. Furnace draft.
20, 21. Draft at economizer inlet and outlet.
22. Draft at air heater gas outlet.
23. Draft at induced draft fan suction.
24, 25. Air pressure at air heater inlet and outlet.
26. Secondary air pressure.
28. Mill differential.
29. Gas temp. leaving reheater.
30. Gas temp. leaving economizer.
31. Gas temp. leaving air heater.
32, 33. Air temp. entering and leaving air heater.
34. Condenser vacuum.
35. Air temp. from pulverizer.
36. Condensate purity in Hotwells.
37. Evaporator vapor purity.
38, 39. Steam temp. to and from reheater.
40. Boiler feed water temperature.
41. Main steam temperature.
42. H.P. turbine exhaust temperature.
43, 44, 45, 46. Heater Nos. 1, 2, 3, 4 bleed temperature.
47, 48. Circulating water inlet and outlet temperature.
49. Condensate temperature in Hotwell.
50. Condensate temperature out of evactor.
51. Condensate temp. out of heater No. 1.
52, 53. Condensate temp. in and out of heater No. 2.
54, 55. Condensate temp. in and out of No. 3 drain cooler.
56, 57. Condensate temp. in and out of evaporator condenser.
58, 59. Condensate temp. in and out of heater No. 3.
60, 61. Condensate temp. in and out of No. 4 drain cooler.
62, 63. Condensate temp. in and out of heater No. 4.
64, 65. Temp. of heater Nos. 1 and 2 drain.
66. Temp. of heater drain cooler No. 3 drain.
67. Temp. of evaporator condenser drain.
68. Temp. of evaporator coil drain.
69. Temp. of heater No. 3 drain.
70. Temp. of heater No. 4 drain cooler drain.
71. Temp. of heater No. 4 drain.
72. Temp. of evaporator vapor.
73. Temp. of makeup water to hotwell.
74. Boiler drum water level.
75. Feedwater flow.
76. Feedwater temperature.
77. 3-Element feedwater flow regulator.
78. Boiler steam and air flow.
79. Condensate flowmeter.
80, 81. Heater Nos. 1 and 2 drain flowmeter.
82. Flowmeter on boiler feed pump discharge.
83. Automatic fuel feed regulator.
84. Automatic air flow regulator.
85. Automatic furnace draft regulator.
86. Motor-driven boiler feed pump automatic control.
87. Automatic mill level controller.
88. Track coal scale.
89. Coal scale.
90. Hot water reservoir temp. and level.
91. Turbine speed.
92. Water temp. to and from hydrogen cooler.
93. Bearing oil temperatures.
94. Raw water temp. to evaporator.
95. Condenser vacuum.
96. Hydrogen pressure and purity
97. Temp. oil to and from cooler.
98. Temp. water to and from oil cooler.
99. Exciter air temp. to and from cooler.
100. Temp. water to and from air cooler.

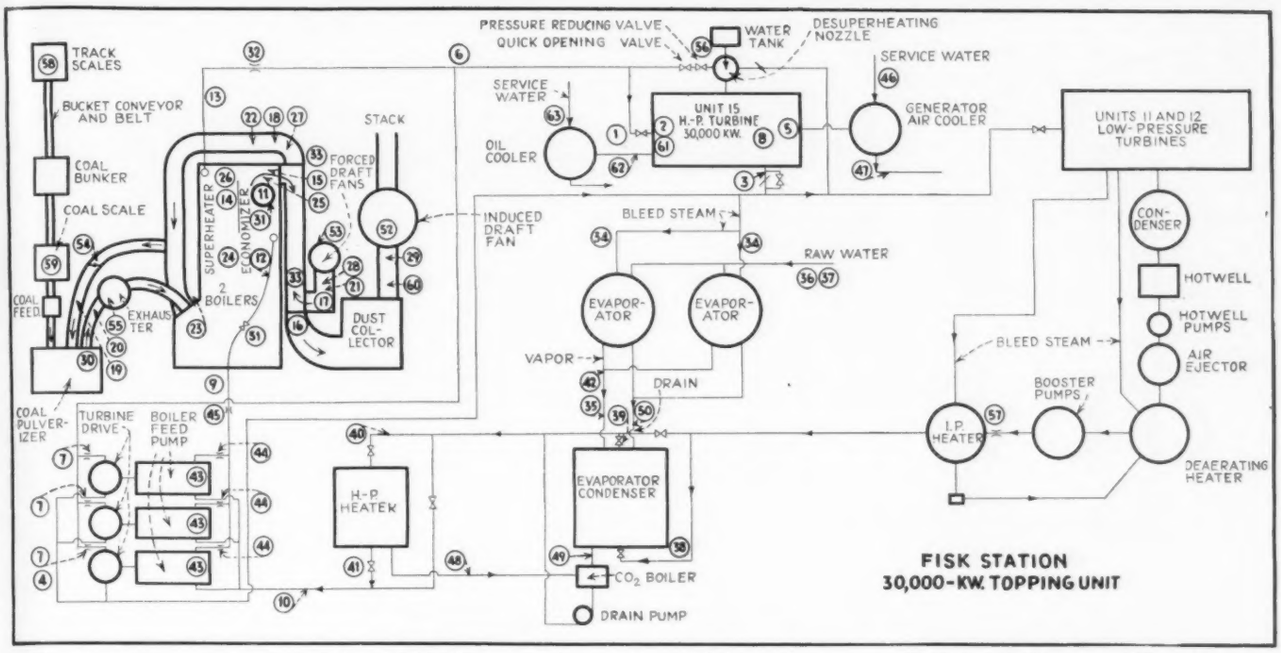


Fig. 2—Instrumentation of the 30,000-kw. topping unit at Fisk station

1. Turbine throttle pressure and temp.
2. 1st, 2d, 3d, 4th admission pressures.
3. Turbine exhaust pressure and temp.
4. Boiler feed pump turbine exhaust pressure, temp.
5. Generator air temp.
6. Turbine steam flow.
7. Boiler feed pump turbine flow.
8. Turbine speed.
9. Boiler feed header pressure.
10. Boiler feed pump suction pressure.
11. Boiler drum pressure.
12. Economizer water inlet temp. and pressure.
13. Superheater outlet temp. and pressure.
14. Flue gas temp. from superheater.
15. Flue gas temp. from economizer.
16. Flue gas temp. from air heater.
17, 18. Air temp. to and from air heater.
19, 20. Air temp. to and from pulverizers.
21, 22. Air pressure to and from air heater.
23. Burner box pressure.
24. Furnace draft.
25. Economizer outlet draft.
26. Superheater outlet draft.
27. Air heater outlet draft.
28. Air heater inlet draft.
29. Induced draft fan inlet draft.
30. Suction pressure on pulverizers.
31. Drum water level.
32. Boiler steam flow.
33. Boiler air flow.
34, 35. Vapor pressure to and from evaporators.
36. Raw water pressure to evaporators.
37. Raw water flow to evaporators.
38, 39. Condensate temp. from evap. cond.
40, 41. Condensate temp. to and from H.P. heater.
42. Conductivity of evaporator vapor.
43. Boiler feed pump differential pressure.
44. Boiler feed pump flow.
45. Feedwater flow.
46, 47. Temp. water to and from air cooler.
48. Temp. drain from H.P. heater.
49. Temp. drain from evaporator condenser.
50. Temp. drain from evaporator coil.
51. Automatic feedwater regulator from drum level.
52. Automatic air flow regulator.
53. Automatic furnace draft regulator.
54. Automatic mill suction regulator.
55. Automatic fuel feed regulator.
56. Automatic desuperheating equipment.
57. Condensate flow from L.P. turbines.
58. Track coal scales.
59. Coal scales.
60. Smoke density indicator.
61. Bearing oil temperatures.
62. Temp. oil to and from cooler.
63. Temp. water to and from oil cooler.

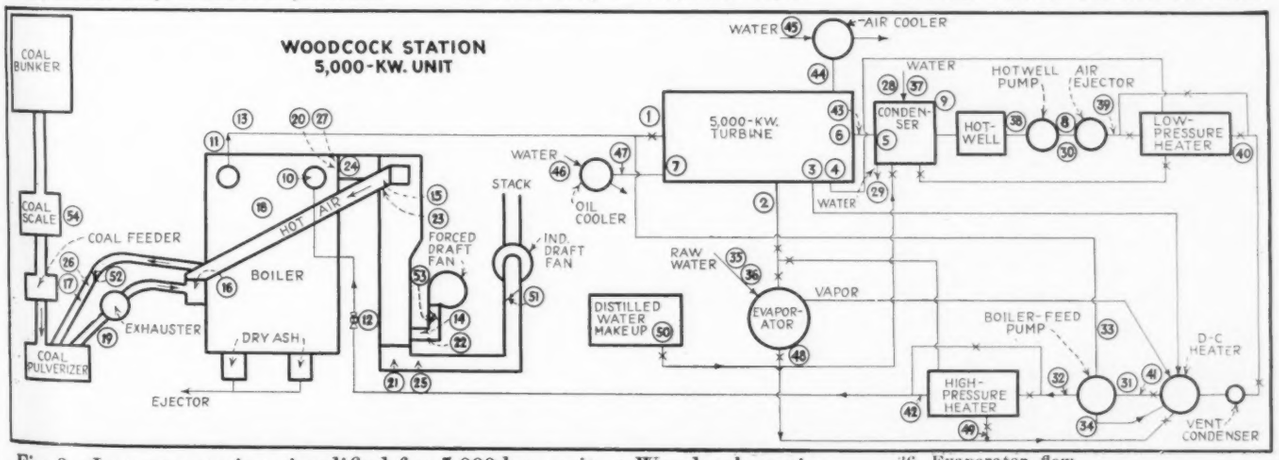


Fig. 3—Instrumentation simplified for 5,000-kw. unit at Woodcock station

1. Throttle steam pressure and temp.
2. First extraction steam pressure, temp.
3. Second extraction steam pressure, temp.
4. Third extraction steam pressure, temp.
5. Condenser vacuum.
6. Turbine speed.
7. Turbine oil temp. and pressures.
8. Condensate flowmeter.
9. Condenser leakage meter.
10. Drum pressure and level.
11. Superheater pressure and temp.
12. Boiler feed pressure and temp.
13. Steam and air flow.
14, 15. Pressure air at air heater.
16. Secondary air pressure.
17. Primary air pressure.
18. Furnace draft.
19. Exhauster suction.
20. Boiler outlet draft.
21. Air heater outlet draft.
22, 23. Air temp. to and from air heater.
24, 25. Flue gas temp. from boiler, air heater.
26. Primary air temp.
27. CO_2 recorder.
28. Circulating water inlet temp. and pressure.
29. Circulating water outlet temp. and pressure.
30. Hotwell pump discharge pressure.
31, 32. Boiler feed pump suction and discharge pressure.
33. Boiler feed pump turbine steam pressure.
34. Boiler feed pump turbine steam exhaust pressure.
35. Water to evaporator pressure and temp.
36. Evaporator flow.
37. Circulating water level.
38, 39. Temp. condensate from hotwell and evactor.
40. Temp. condensate from L.P. heater.
41. Temp. condensate from D.C. heater.
42. Temp. condensate from H.P. heater.
43. Exhaust steam temp. from turbine.
44. Temp. air to and from air cooler.
45. Temp. water to and from air cooler.
46. Temp. water to and from oil cooler.
47. Temp. oil to and from oil cooler.
48. Temp. of evaporator coil drain.
49. Temp. of H.P. heater drain.
50. Makeup water temp.
51. Air flow regulator on automatic combustion control.
52. Fuel feed regulator on automatic combustion control.
53. Furnace pressure regulator on automatic combustion control.
54. Coal weight.

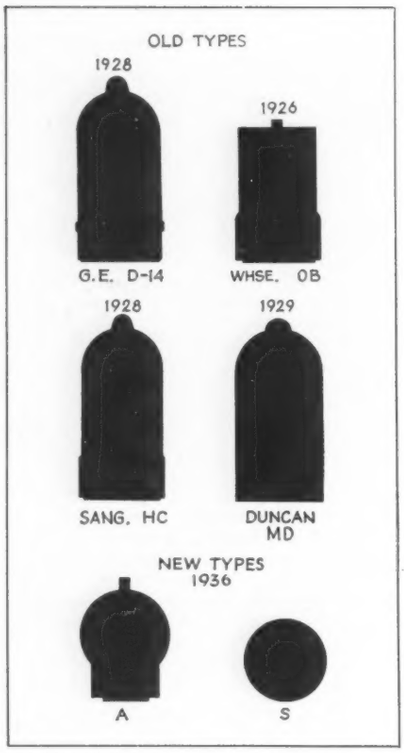


Fig. 1—Two-element polyphase meter now lighter, smaller and cheaper

	Average Reduction in Per Cent	
	Type A	Type S (Detachable)
Net weight	54	63
Mounting area	42	54
Size	35	55
Cost	33	36

Customer Metering Now

By A. J. ALLEN
Meter Engineer
Meter Engineering Bureau
Consolidated Edison Company
of New York, Inc.

THE ADVANCEMENT in the metering art brought about during the past twelve years is the greatest in the history of metering and the cycle is about complete. Further refinements appear unnecessary and should be avoided; they generally increase costs and prevent price reductions. What we now have will be adequate for a long time to come.

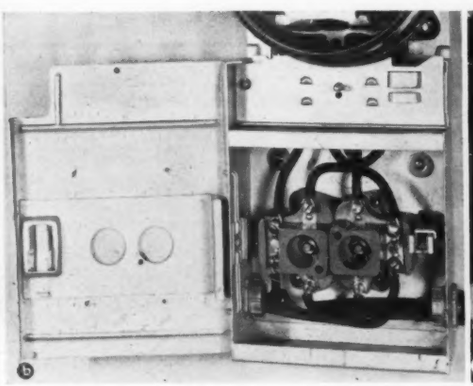


Fig. 2—New meter cabinets or inclosures devised

(a, b) Self-locking door may be opened only by removing the meter cover, thereby providing clearance for the cabinet door to move upward to its release position. Openings through cabinet door are for purpose of disconnecting for non-payment or other reasons. Disconnect is made with insulated socket wrench, which operates disconnect device on load side of meter. Cabinet accommodates all makes and types of old and modern two- or three-wire, single-phase, bottom-connected meters. One seal on the meter protects both meter and cabinet. Similar cabinets are used also for polyphase and instrument transformer meters. When the door of this cabinet is in the closed and locked position the door is locked on both the right and left sides so that even though door hinges are broken access to the interior is still not effected. (c, d) Partial inclosure for meter, protected with porcelain seal inserted in lower front of cabinet. Seal upon being inserted automatically locks in place and must be destroyed in removal. Seal protects cabinet locking mechanism and seal hole provides access for a special key to unlock and remove cabinet cover. These cabinets accommodate old and modern single-phase and polyphase bottom-connected meters. Attention is directed to the use of a circuit breaker at service entrance in place of fused service switch. (c) Residential installation with service-entrance circuit breaker. (d) Grouped installation; one-, two- and three-element meters with service-entrance circuit breaker.

Established on Durable Basis

Fruition of 14-Year Evolution Has Brought About Major Elements of Economy, Space Saving and Prevention of Energy Diversion

STANDARDIZATION of self-contained meter ratings of 5, 15 and 50 amp. has simplified the production and stock problems of the manufacturers and has made possible a number of price reductions. The standard sizes also have a considerable extended or overload capacity, which is from three to four times their nominal ratings. Thus the meter of today costs far less per ampere of capacity than the old types of the same nominal rating. With fewer sizes of greater actual capacity many operations of the utility companies have been simplified.

Assignment of modern meters to residential and small commercial customers does not require the caution heretofore exercised to prevent overloading or burning out of meters. Replacements due to increased customer load have been reduced. The 15-amp. size has become almost universal in its application to residential and small commercial installations and there is a trend away from the use of 5-amp. There are also advantages to be had in reducing stocks of meters, repair parts and attachments such as demand registers.

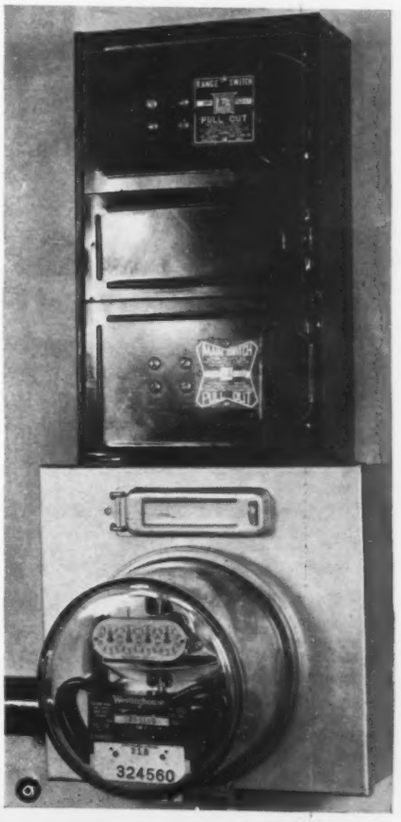
In addition to the above, there has been a revolutionary change in polyphase meters, which is the last part of the development cycle, whereby the meters have been greatly reduced (Fig. 1) in weight and dimensions, and in some sizes price reductions have been made. The modern three-wire polyphase meter is of the same general dimension as the single-phase meter and has the same mounting arrangements. This eliminates the need for various polyphase meter mounting equipments or inclosures and permits one design to accommodate either single-phase or three-wire polyphase meters, thus saving in the cost of meter mounting equipment and installation.

Such an installation has the advantage of being readily changed from single phase to polyphase and therefore provides for future increase in customer loads without change of the meter mounting equipment. This is a decided advantage where the meter is installed on the outside of a building, because the appearance of the meter installation remains unchanged. The size and weight of four-wire, three-element polyphase meters have also been reduced.

Reduction in the size of polyphase meters has greatly reduced the weight of the moving element and

Fig. 3—Cabinets and troughs for detachable meters

(a) A single-meter cabinet.
(b) Trough-mounting arrangement for grouped installations.
The detachable meter equipment accommodates two- and three-wire, single-phase and three-wire polyphase meters and has a non-payment disconnect arrangement similar to that of the cabinet shown in Fig. 2b. The trough is provided with connectors and conduit openings to accommodate service cables from No. 6 A.W.G. to No. 4/0 A.W.G. The meter seal protects both the meter and the cabinet.



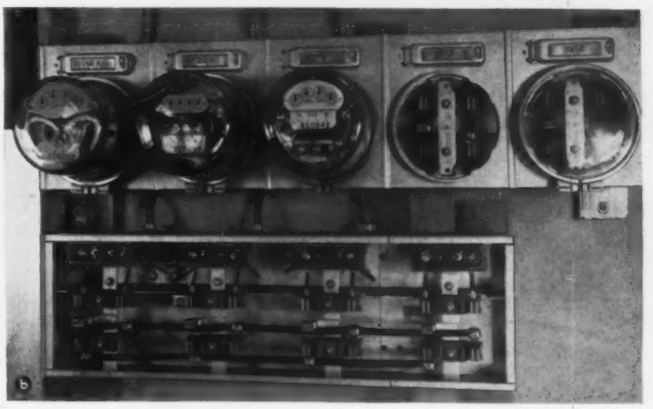


Fig. 4—Water heater time switch grouped with detachable meters in outdoor installation

the life of the lower bearing will be increased.

Modern meters for use with instrument transformers have a rated capacity of 2½ amp. for the purpose of measuring more accurately light loads and carrying the burden of contact devices for demand metering purposes.

Bearings and characteristics improved

There has been a general demand to obtain non-corrosive meter bearings that would not require lubrication. Employment of a stainless steel ball meets this demand and there has been a trend toward the use of ball type of bearings.

All modern meters have been compensated for temperature and provide equally accurate performance indoors or outdoors. Glass meter covers are now generally used and for modern meters the old style cover-supporting studs have been eliminated as a protection against energy diversion.

A most important development has been the standardization of meter bases, whereby all manufacturers use the same mounting dimensions to cover two classes of meters—the bottom-connected type, known as the "A," and the detachable type, known as the "S." This reduces the number of mounting arrangements and simplifies installation.

Energy diversion, which became a major problem during the past six years, has drawn attention to the inadequacy of service entrance and meter equipment to provide necessary protection. Many utility companies have carried on extensive rehabilitation programs to correct the situation. Concentric service entrance cable, armored with the neutral conductor for overhead service from the pole to the meter, is displacing other forms of service conductors mainly as a means to prevent unauthorized connections to unmetered wires.

The installation of meters on the outside of buildings has proved an effective means of preventing energy diversion. This has been made possible by the new sequence of meter connections allowed by the National Electrical Code, whereby the meter may be connected ahead of switch and fuses. This permits the meter to be outside and the switch and fuses inside the building, both of which are on metered circuits. The size of service conductors for general use is becoming larger and No. 6 is now the general minimum.

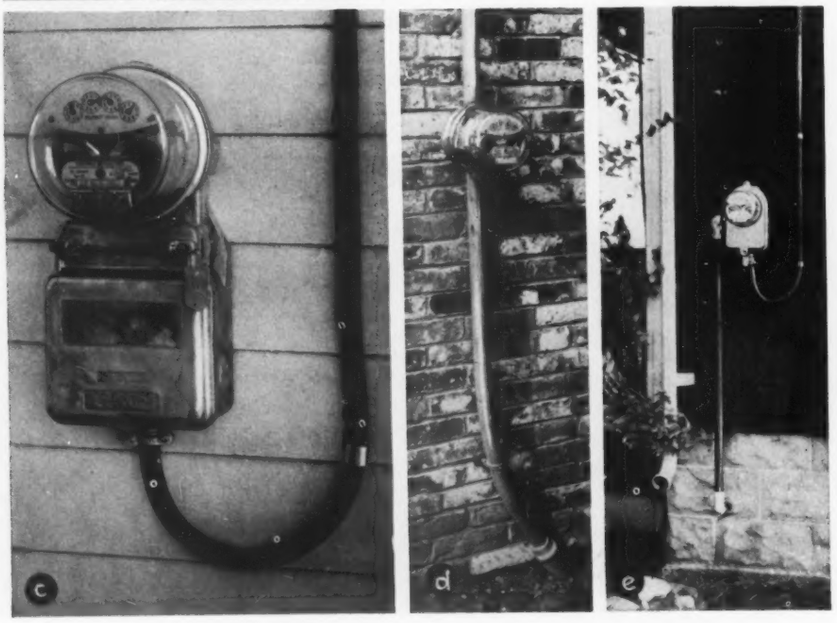


Fig. 5—Outdoor metering installations typical of current practice

(a) Bottom-connected meter.
(b) Single-phase meter in G.E. all-service box.
(c) Bottom-connected (A) meter with concentric service entrance cable.
(d) Detachable meter outdoors.
(e) Partial inclosure for G.E. detachable meter outdoors.

Protection of indoor meters

Providing proper protection for indoor metering has presented problems difficult of solution.

For the protection of indoor meters a number of new and novel meter cabinets or inclosures have been developed (Figs. 2 and 3).

Detachable meters which have found extensive use for outdoor installations have been delayed in their application indoors principally due to the development of meter-mounting arrangements for single and grouped installations.

The novel cabinets in Fig. 3 are described very briefly with an object of indicating the revolutionary change that is under way to provide adequate protection under a single meter seal for indoor metering. The extent of energy diversion has not yet been fully recognized, although it reached serious proportions in 1932.

Grouping of meters in outdoor installations has advanced with the

development of trough, cabinets and inclosures to meet new requirements for larger service conductors, concentric service cable entrance and the standardization of detachable terminal arrangements. Grouped installations, including a time switch for the control of water heating, are shown in Fig. 4. Typical outdoor meter installations are shown in Fig. 5.

Current transformers also evolving

The development of current transformers to meet present and future requirements has lagged behind that of the watt-hour meter. Current transformers for low-voltage metering have been generally limited to the multi-turn type, with high-voltage ratings, low thermal capacity and practically no overload range, and were available as standard only up to 1,000 amp. capacity. With the advent of low-voltage network distribution systems it became necessary to obtain current transformers, specifically for metering purposes, with a low-voltage rating, high thermal capacity and of high mechanical limit to withstand without injury severe short-circuit currents, a continuous overload range up to 150 per cent of nominal current rating and available in current capacities from 200 amp. to 2,400 amp. (Fig. 6a).

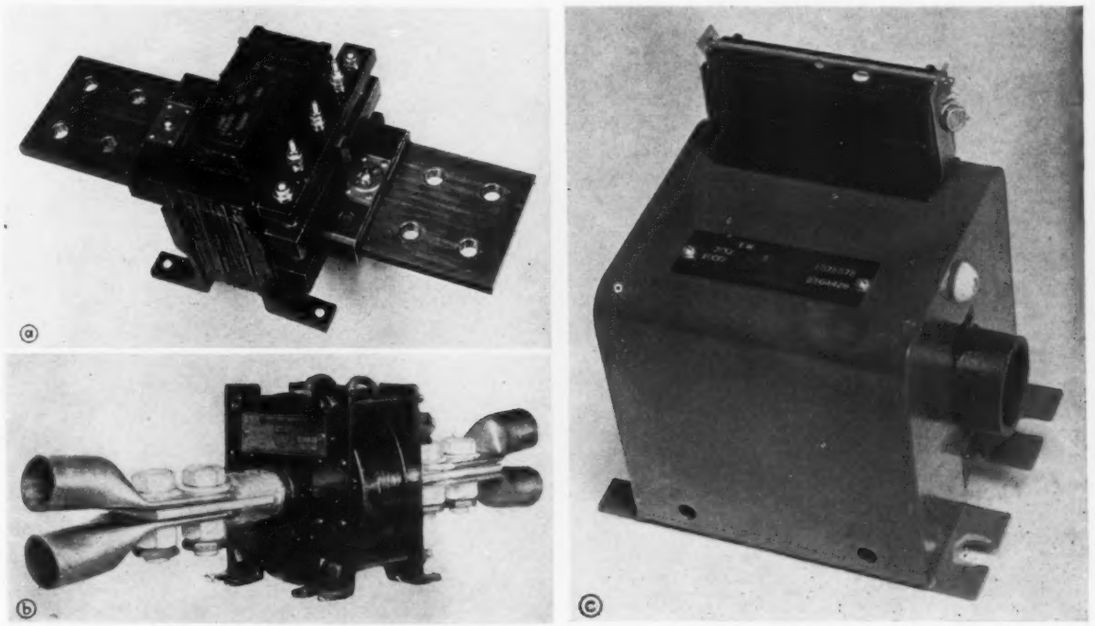
Through-type current transformers with phase angle and ratio errors equal to, or less than, the best wound types were produced that met all these requirements. The cost, however, has been high, especially in the small capacities. The advantages to be obtained have created a demand and the manufacturers are giving the matter serious attention, and as a result one manufacturer has advertised a through-type current transformer in two capacities at a reasonable price. (Fig. 6c.) This development in low capacities will probably not be limited to the through-type as there are indications that the multi-turn type may be improved to meet the requirements. This development will undoubtedly lead to obtaining current transformers at a lower price per ampere of capacity than heretofore. The advantages to be gained are many and fewer sizes need to be stocked to cover the metering range.

One company which stocked eight sizes of multi-turn transformers for metering circuits up to 1,000 amp. now stocks six sizes for metering circuits up to 2,400 amp. The continuous overload range of 150 per cent provides sufficient excess capacity, where transformers are installed on the basis of their nominal rating, to take care of additional customer loads without transformer replacement. Generally the excess transformer capacity exceeds that of the customer's wiring. The through-type requires less space and may be installed directly on a bus or cable or have primary terminals. Faults associated with primary windings are eliminated.

The resultant error due to phase angle and ratio errors, which is usually applied as a correction factor in determining meter accuracy, may be discarded as it is less than 0.5 per cent for any power factor from 50 per cent lagging to unity. The importance of this will be recognized by those who have had to supervise the calculation and application of such factors.

Switch and fuse boxes designed for range and lighting circuit fuses have been made in a variety of sizes and prices and difficulty was experienced in associating them with service or meter equipment. This was called to the attention of the switch and box manufacturers with an idea of reducing the cost of range installations and obtaining co-ordination between the customer's load center box and utility meter or service equipment. This resulted in dimensional limits being agreed to and a reduction in cost.

Fig. 6—New current transformers meet low-voltage network needs
(a) Sangamo through-type (400 amp.) C.T. with primary terminals.
(b, c) Westinghouse through type current transformer, 400 amp., with (b) and 200 amp. without (c) primary terminals.



Bulk Power Metering Rests on Instrument Transformers

By A. S. ALBRIGHT . . . W. J. PIPER

Superintendent of Meters — *Engineer, Meter Department*
The Detroit Edison Company

DELIVERY of power or energy in large or wholesale quantities involves what may be called metering. In order to deliver such amounts of power or energy economically and efficiently high-voltage polyphase circuits are used, over which large currents are very often carried. These factors make it necessary to employ instrument transformers for metering such circuits. These instrument transformers insulate the meters from the high voltage and reduce the voltages and currents to metering levels. In addition to the measurement of kilowatt-hours, or energy, it is usually necessary to determine several different quantities not often considered on smaller installations, and this fact, plus the high premium on accuracy, make bulk power metering a complex problem.

The rate usually requires the measurement of several quantities such as kw.-hr., rkva.-hr., average kw., average rkva., kva., etc., on installations measuring service sold or purchased. Installations used for statistical or operating purposes may require kw.-hr., instantaneous kw. and rkva., power factor, and other quantities. Occasionally the same installation may be used for all.

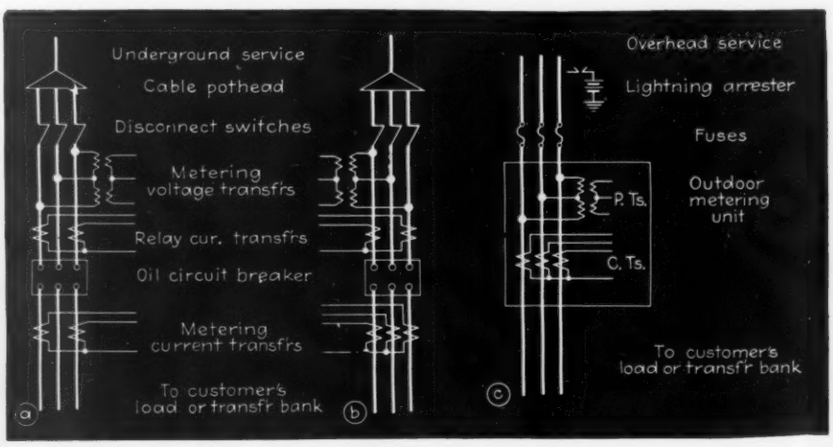
The meters installed will be determined by the information required and by whether or not any of the quantities to be measured are to be recorded or are to be transmitted to another location. It may be that one or more of the quantities measured are to be totalized with similar quantities on other lines at the same location or at another location some distance away.

Since the quantities measured are large, a high degree of accuracy is important, and particularly is this true of the quantities that are integrated. More than ordinary care should be exercised in the choice of metering equipment and in the manner in which it is installed.

The most common and straightforward method is to install the instrument transformers in the line where the service is sold or purchased, or where the information is wanted. In order to avoid the expense of high-voltage instrument transformers and to reduce the risk of failure to such equipment, the installation may be made at some other point (on the low-voltage side of a transformer bank, for example). The losses between the two points may be compensated for, or measured on auxiliary meters. The proper compensation for, or measurement of these losses, depends on a knowledge of the loss characteristics of the apparatus and line between the two points. Such an installation, if properly installed and with the meters properly calibrated, will give very satisfactory results. The arrangement has limitations, however, and is not always applicable. If there is any doubt, the first method should be employed.

The nominal ratio of the voltage transformers will be determined by

On this 4.8-kv. installation kw.-hr., rkva.-hr., kw. demand, time demand occurred are required
The cover was removed from the meter connection box to show the test switch, the phasing transformer for the rkva.-hr. meter and the fuses in the demand meter circuit.



Equipment commonly used to serve a bulk power customer at 4.8 kv.
(a) The difference in ratios between the relaying and metering current transformers is so small that one set can be compared with the other by means of a wattmeter or portable test meter. The customer's load can be used for this purpose. (b) Three current transformers are installed for metering, since the difference in ratios is too large for direct comparison. In this case the metering transformers are interchecked.
Voltage transformers supply the energy necessary to operate demand meters in addition to supplying the metering voltage and are connected ahead of the oil circuit breaker in order to obtain an uninterrupted demand record even though the oil circuit breaker may be opened. Demand meters are so connected that they will cease to function if either or both of the voltage transformers fail.
(c) Arrangement of 4.8-kv. equipment when fuses are used for protection and no provision made for the customer to disconnect or restore service himself. The outdoor metering unit is simply a sheet metal housing in which standard 5-kv. instrument transformers are mounted.

the voltage of the line to which they are connected. The nominal ratio of the current transformers will be determined by the amount of current that is to flow. Multi-ratio current transformers can be used to take care of future load increases.

Since metering requires maximum accuracy in current transformers at normal currents, and protective devices require maximum accuracy only at fault currents, it is seldom that the same set of current transformers can be used satisfactorily for both purposes.

Ratio and phase-angle characteristics of the instrument transformers should be such that kw.-hr. and rkva.-hr. will be measured with acceptable accuracy under all conditions of power factor and load that are likely to be encountered.

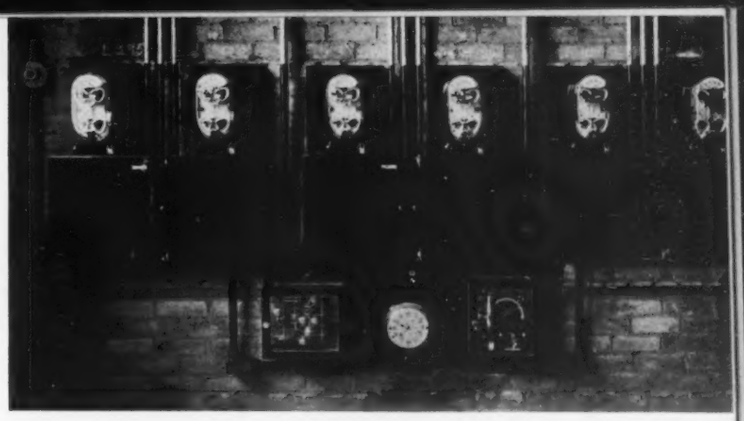
All instrument transformers should have sufficient insulation to withstand the normal and the abnormal voltages to which they may be subjected. In this respect they should be co-ordinated with other apparatus in the line. Current transformers should have sufficient mechanical strength and thermal capacity to withstand any abnormal or fault currents to which they are liable to be subjected.

Standard makes and types of instrument transformers and meters should be used whenever possible. Their design and construction have been proved and their performance can be quite accurately predicted. There is a very wide variety of such equipment available and it will seldom be necessary to resort to special designs to obtain satisfactory apparatus.

Equipment should be installed in such a manner that each piece is accessible for inspection, maintenance and replacement. The instrument transformer secondary wiring should be so installed that it can be readily checked and easily replaced. The impedance of this secondary wiring should be kept as low as possible. All concealed wires should have their ends clearly identified. Test facilities should be provided in the secondary wiring so that the meters can be tested and maintained with safety and convenience.

Installation of fuses in voltage transformer leads, particularly on the high-voltage side, is usually a poor practice. Experience has shown that the protection offered by fuses is not worth the risk of high resistances or actual breaks in the circuit due to the presence of the fuses.

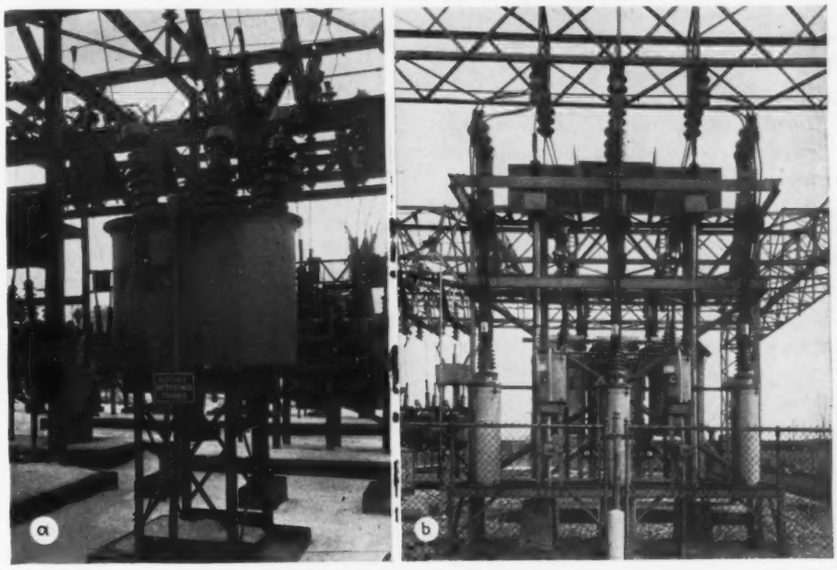
Particular care should be exercised at all connections to see that there is a good electrical and mechanical contact and that there are no stray strands of wire or other conditions which may cause a short circuit or open circuit, resulting in inaccuracies or damaged equipment.



Installation served by three separate lines—Separate kw.-hr. and rkva.-hr. meters for each — Coincident demand and time demand occurred are registered on demand meter

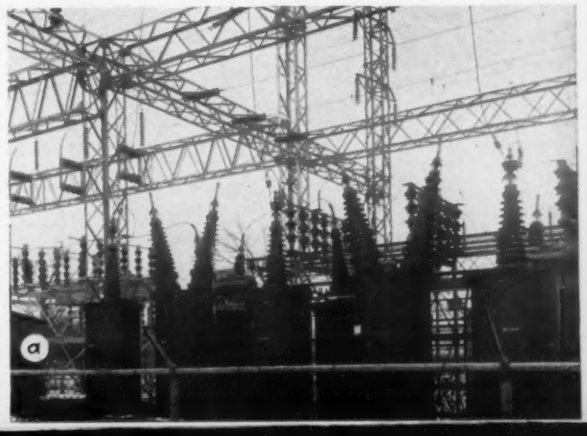
Instrument transformers separate or combined

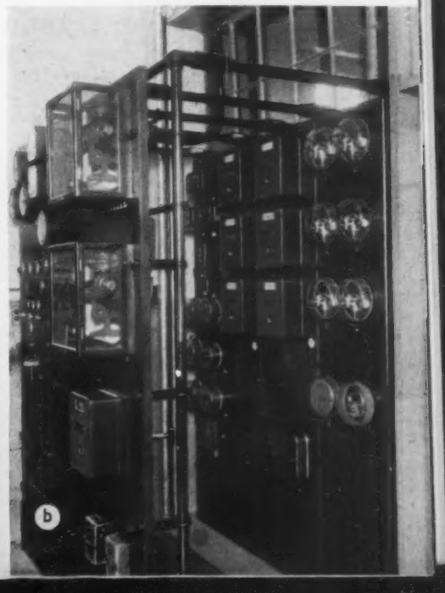
(a) A 24-kv. outdoor metering unit metering service to a street railway converted. Three current transformers and two voltage transformers in the oil-filled tank. Current transformers are double ratio and connections for changing the ratio are at top of bushings. Secondary leads are brought to a terminal board in a small compartment at top of tank. (b) A 13.2-kv., three-phase, three-wire installation employing separate instrument transformers. There are three current transformers and two voltage transformers.



Separate instrument transformers are used on a 120-kv. interconnection

Secondary leads are lead cables carried in conduit underground to panels in station control house. Third panel from right in rear has test facilities and meters for measuring kw.-hr. rkva.-hr. lagging. rkva.-hr. leading when power is flowing "out." The second panel from the right in rear has meters for measuring these same quantities when power is flowing "in." Also on this panel is the transmitting equipment of a telewattmeter. On the first panel on the right in rear are instruments which record reading of all integrating meters every fifteen minutes. On the first panel on the right in front is a graphic wattmeter, a graphic rkva. meter, a power directional relay and two auxiliary relays. These last three pieces of equipment throw the metering voltage back and forth from one set of integrating meters to the other set, depending on which direction power is flowing. Third panel from the right has indicating meters for operator's information. There is a wattmeter, an rkva. meter, a voltmeter and three ammeters. The other panels contain relays and control equipment and are not connected in any way with the metering.





Integrity of Measurement Upheld by the Laboratory

Utility standardization laboratory a versatile agency for accuracy in operations, sales and purchases

By WALTER C. WAGNER

Operations and Engineering Departments, Philadelphia Electric Company

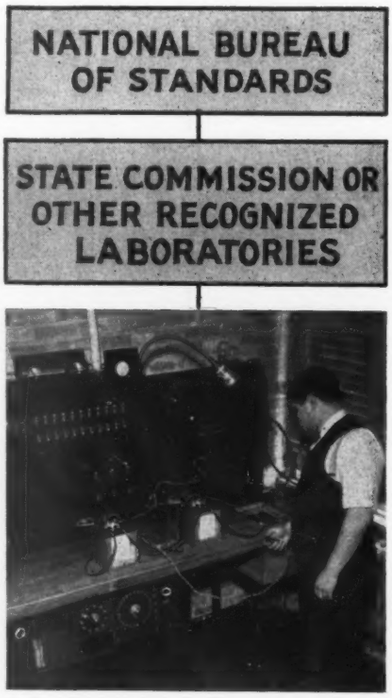
MAINTAINED integrity of electrical measuring instruments is the primary responsibility of the laboratory of an electric public utility. The functional task of those instruments is to supply to the operators the desired characteristics of machines, equipment, lines, meters and auxiliaries. These start with the character of *measurements at the coal pile or water fall,* and continue on through the *prime movers, auxiliaries, transformers, switches, lines, substations, distribution* and the *metering and use by customers.*

In addition, such a laboratory is responsible for instruments and auxiliary measuring equipment used in less evident functions, such as *load and loss surveys, characteristics of customer use,* the many kinds of *protection against disturbances, service interruptions,* the assurance of *accurately timed frequency* for clock operation, the determination of *performance of electrical appliances* sold to customers and *research in general* leading to greater economies and a higher quality of service.

In many companies the laboratory serves also in making acceptance tests of equipment and materials and co-operates with other departments in the determination of test methods and selection of facilities for operations. Frequently tests and investigations are made in the field and on customers' premises by laboratory personnel with portable equipment. There has developed, with the increasing number of interconnections between companies, a closer co-ordination of company laboratories, resulting in a greater degree of standardization of operations, simplification of methods and a lesser diversity in types used. Co-operation with the laboratories of manufacturers, of regulatory bodies and of nationally-recognized private laboratories is equally necessary and of mutual advantage.

The standards of reference for all measurement of time, dimensions or mass must be unquestioned. Therefore primary electrical standards approved for use by the United States Bureau of Standards are used in every such laboratory. The Bureau of Standards, in turn, participates with national standardizing laboratories of other nations to maintain the international uniformity of measurement.

While under some conditions the design and use limitations of instruments tested by a laboratory do not require a high degree of precision, yet even there an accurate reference standard serves to determine properly the relative degree of accuracy.



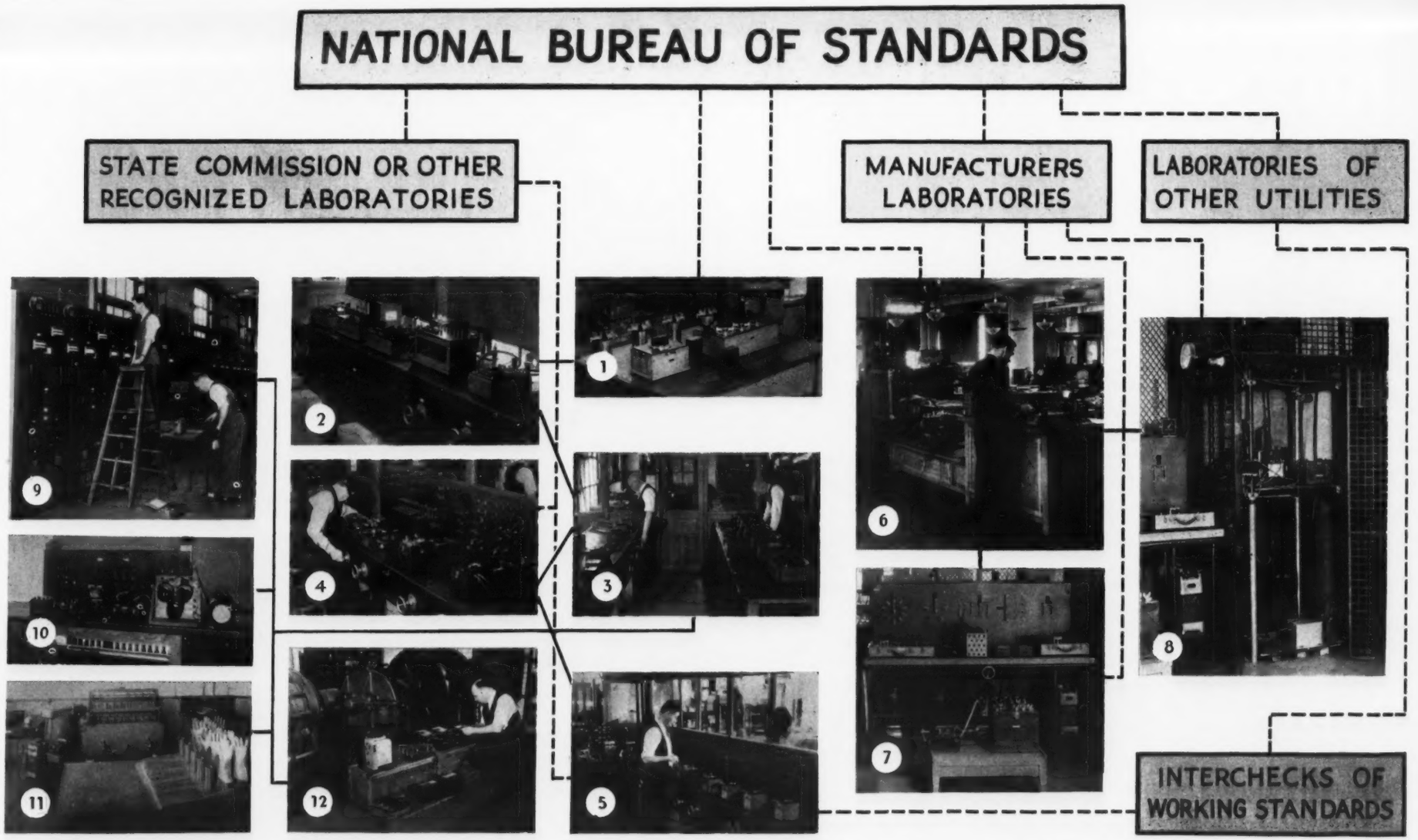
A small utility may test its working rotating standards with a master standard certified by a state commission or other recognized laboratory

With respect to many research and many other high precision instruments, including metering upon which customer billing is based, there is required the highest practicable degree of calibration accuracy, limited only by the characteristics of laboratory and field instruments, methods of test and field conditions. Such accuracies are maintained by periodic testing by the laboratory.

Primary and reference standards

The larger utilities have *primary* standards, consisting of standard resistors, standard cells, standard capacitors, etc., and the necessary precision measuring equipment, such as potentiometers, Kelvin bridges and Wheatstone bridges. The basic standards are periodically certified by the Bureau of Standards to a high degree of accuracy, and in the meantime comparisons between the utility's primary and secondary standards serve as a check on their continued integrity.

These instruments serve for maintaining the accuracy of the highest-grade laboratory indicating instruments, which are placed in a protected location, always kept in position, and are designed to facilitate accurate reading. It is these instruments which serve for the calibration of the *reference* standards, such as the master rotating standards, which, in turn, maintain the working field standards used for testing. The master standards, in general, maintain their accuracy within a small fraction of a per cent over many successive periodic checks. Working standards are calibrated in the laboratory by comparison with these master standards, and the customers'



1. Primary standards of a utility's laboratory are checked by the Bureau of Standards. This group embraces standard cells, standard resistors, potentiometer and volt box and precision galvanometer.

2. Secondary standards are used for intercomparison with primary standards to assure continued integrity of precision measurements.

3. Laboratory standard instruments (right) serve for checking high-grade portable instruments (left).

4. Checking master rotating standards periodically assures continued integrity.

5. Frequent checks of working rotating standards with master standards form basis of maintained accuracy of customers' meters.

6. Testing of a working standard current transformer with a primary standard transformer.

7. Test equipment for service type current transformers using a working standard.

8. Potential transformer and insulation test equipment. The equipment cannot be energized when safety door is open.

9. Relays and station instruments are maintained in proper operating condition in the field.

10. Relays are tested in the laboratory to determine their characteristics.

11. Rubber gloves are tested for electrical insulation.

12. Graphic and indicating instrument tests determine the characteristics of equipment.

meters are in turn calibrated in the field by the working standards.

It is largely due to the care exercised by meter testers and the background of good instruments and accurate measurements provided by the calibration laboratory that the watt hour meter has maintained its enviable reputation for accuracy.

For the smaller companies to assure metering accuracy the check of working standards is generally obtained by maintaining one or more master rotating standards, certified as to accuracy by the state commission or other recognized laboratory. Experience has indicated this method to be equally practicable in a larger company for local subdivisions located at a distance with its central laboratory checking these master standards.

Instrument transformers

Current and potential transformers are frequently used for metering, instrument and relay circuits. The calibration laboratory maintains standard current and potential transformers in the commonly used ratings. These transformers have their characteristics determined and certified by the Bureau of Standards, by state commission, or by other recognized laboratories. These standards serve for the calibration of working standards, which, in turn, are used for determining the characteristics of instrument transformers.

Manufacturers' laboratories with precision test equipment may furnish certified test results, particularly for small companies with insufficient numbers of transformers to warrant the investment in standardizing equipment of this nature. This applies also for larger companies in the case of a relatively small number of transformers of unusual ratings which would require the purchase of costly and infrequently used test equipment.

Associated with the calibration laboratory is also the precision calibrating equipment for an innumerable number of other electrical measurements. In this class are the calibration of normal and extreme-temperature *thermometers and pyrometers*, accurate means of measur-

Standard Instruments

By C. P. ZIMMERMAN

American Gas & Electric Service Corporation, New York

INGENUITY of the engineer is taxed at times when conditions make it necessary to deviate from conventional methods of electrical measurements. Contracts involving delivery of large blocks of power and interchange agreements involving predetermined load schedules and tie line and frequency control sometimes call for unique and special metering of various electrical quantities. Load dispatching and system operation, especially on interconnected systems, also require reliable information by indicating or graphic instruments or integrating meters.

Each installation of this sort is a separate problem and requires study to ascertain the best solution from an engineering and economic standpoint. The problem usually is not so much the design of new equipment but the application of present standard devices to perform functions for which they were not originally intended. This does not mean that methods involving the design of new (anything new is usually considered unique) equipment should not be considered and analyzed, for sometimes present methods or equipment are so far from being adaptable to an installation that a novel design will not only be more practical but also more economical.

In general, it will be found, however, that the best procedure is, in so far as practicable, to make use of equipment already on the market and which experience has proved to be sufficiently accurate and reliable. This is primarily due to the high cost of developing new or special equipment.

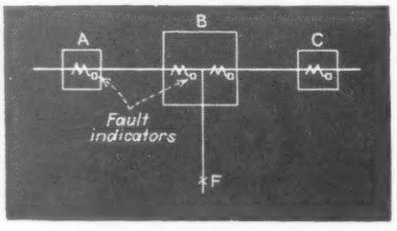


Fig. 1—Reactive meter functions as fault indicator

The accompanying examples may be considered unique and interesting in that they involve a bit more than the ordinary measurement of watts, volts, etc. As stated above, each was a special problem, each had definite conditions and limitations:

Figure 1

One of the problems of an operator on any extensive, interconnected power system is to determine, without undue loss of time, the location of system troubles. On such a system the only normal indication at the point where the operator is located of faults beyond adjacent sectionalizing parts may be a power or voltage surge; this, however, will probably not give him any clue as to the location of the trouble. If, on the other hand, the operator has an indication of the direction from which the trouble came he can more readily determine his next move.

While there probably are a number of relay schemes that would be applicable for this purpose, the device described here was found to be suitable and easily adaptable, although relatively inexpensive. Making use of the well-known fact of the heavy flow of reactive current toward the fault, a polyphase watt-hour meter mechanism measuring reactive energy was used. A spring was substituted for the permanent magnets for counteracting the driving torque of the meter. The meter had a scale calibrated in reactive volt-amperes. A pointer fastened to the spring is manually set to indicate the normal reactive power for any normal condition as determined by the load schedule. When the torque due to the reactive energy passing through the meter exceeds that of the spring beyond an established percentage of the setting, a pair of contacts in the meter closes operating targets or lights showing the direction of flow of the reactive current and therefore of the fault.

Suppose a fault occurs at point F of the system. The operator at station A can tell from his fault indicator that the direction of the fault from A was toward but beyond B. The operator at B can, by means of similar instruments, determine the direction of trouble from B and pass the information by telephone or otherwise back to A.

This method of locating trouble can also be used to advantage on feeder circuits emanating from important transmission or distribution stations.

Figure 2

The usual method of remote metering or indication of energy consumption involves a continuous integration at the receiving meter of some quantity that varies with the speed of the disk of a watt-hour

ing *inductance*, *capacity*, *frequency*, *light intensity* and *speed*, as well as standard *clocks* maintaining synchronism with Standard Time. Oscillographs serve for determining wave shapes and high-voltage test sets are used for determining the characteristics of cables and equipment.

Broad responsibility of laboratory

In more practical terms, an electric public utility, to maintain a satisfactory service, must have an accurate timed frequency to keep time switches, demand meters and customers' synchronous clocks on correct time; cables, both aerial and underground, must be reasonably free from faults or failure; transformers must be guarded against overload, to avoid radio interference they must be free from static leakage, and they must be reasonably proof against disturbances; grounding systems on lines and in stations must be adequate and so maintained; circuit breaker and transformer oils must be initially and periodically tested for voltage breakdown and chemical content; coal must be tested for its heating and other characteristics, and temperatures of steam, generators, transformers, conduits, etc., must be measured properly and recorded; steam and water flow must be determined.

Electrolysis tests in the laboratory and in the field, and scores of other tests involving electrical physics in all its branches, are made continually to assure that the electrical customers may have adequate and uninterrupted service.

It is therefore evident that a well-equipped standardizing laboratory, such as may be maintained by a large electrical utility, must represent a considerable investment in instruments, auxiliary equipment and maintenance, and this investment is entirely warranted when the importance of accuracy is considered.

Acknowledgment is made of the important contributions to this article by H. S. Phelps, W. A. Fogler, and C. B. Flack, of our engineering department laboratory, and G. B. Schleicher, of our operating department laboratory.

Adapted to Special Uses

meter installed at the transmitting end. In the method cited below, the position of only the first dial pointer is transmitted and read periodically on a deflection instrument at the receiving end.

(a) Two hydro generating stations, each having three generators, were controlled from a third station located approximately 7 miles from one hydro station and 7½ miles from the other. It was necessary that the operator at the controlling station have an indication of the energy output of each generator at various periods throughout the day. A variety of methods of accomplishing this were suggested, such as the use of an impulse scheme operated from contacts in the watt-hour meter and sending these impulses over a metallic circuit or by carrier current to operate a printometer or any device with a standard meter register. This necessitated either a metallic circuit or carrier channel in continuous operation.

A further analysis revealed that a supervisory circuit was already in operation between the two hydro stations and the controlling station for controlling each of the generators and circuit breakers and also, by dialing, the operator could read on a receiving meter the instantaneous watts and volt-amperes of each generator.

(b) If this present supervisory circuit could be used to obtain watt-hour readings in addition to its other functions, an appreciable saving was possible, since it would eliminate the necessity for metallic circuits or for carrier equipment.

In brief, the operation of the equipment used is as follows:

A contact device on the watt-hour meter in each generator circuit initiates impulses at a rate proportional to the power (kw.) generated. These impulses actuate a notching relay, which in turn drives the movable arm of a circular potentiometer connected across the supervisory battery. By using a comparatively high impulse rate the potentiometer arm is made to vary and keep in step with the position of the first dial pointer of the watt-hour meter. Care should be taken, however, that the first dial pointer will always make less than one revolution per reading period at the receiving end.

At the receiving end the operator, by means of the supervisory equipment, selects the particular watt-hour meter he wishes to take a reading of and reads the position of the first dial pointer on voltmeter having a linear scale and ten major scale divisions corresponding to the meter dial. The difference between this reading and the last previous reading gives him the energy output for the period. With a large scale on the receiving instrument the energy can be read more accurately than on the watt-hour itself.

By keeping a running log it is possible to have the actual total register reading available continually. For example, suppose the last register reading was 3579 and the first dial pointer now is at 3. The new reading would be 3583.

Figure 3

A contract required that all energy taken when the demand exceeded the contract capacity be metered separately from the total consumption. The simplest way of accomplishing this was found to be a differential installed in the register of a watt-hour meter.

(a) One side of the differential is driven by the meter shaft; a synchronous motor drives the other at a speed proportional to the predetermined limit. The difference of the two is indicated on the register dials.

(b) Another method is to use a watt-hour meter with an extra current winding or element and pass a controlled or regulated phantom load through it equal to the predetermined demand. Such a meter is somewhat more flexible since the phantom load can be readily changed by varying the current, when necessary, due to a change in contract capacity, whereas in the differential register type it would be necessary to change the gears. The accuracy of this method is dependent on maintaining a constant load current for each setting.

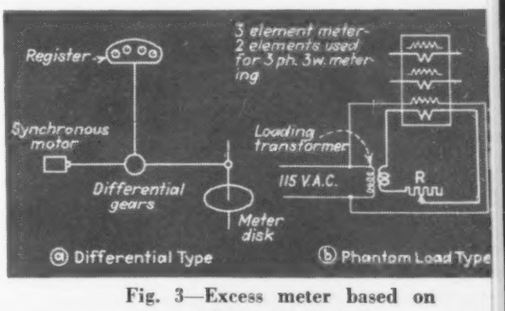


Fig. 3—Excess meter based on differential register

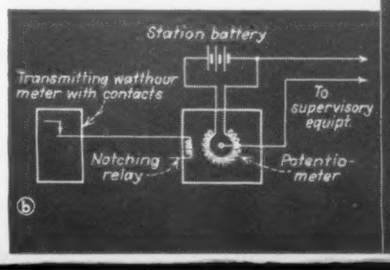
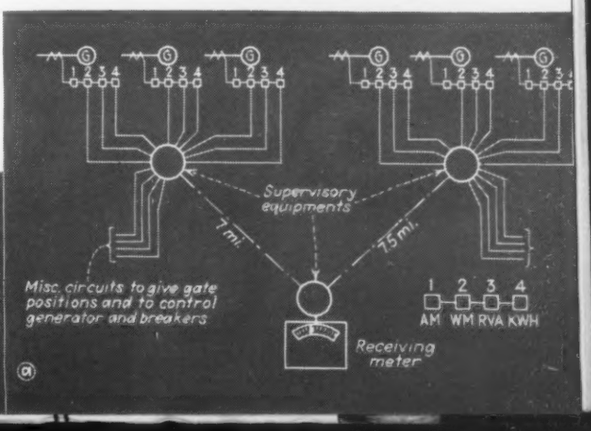
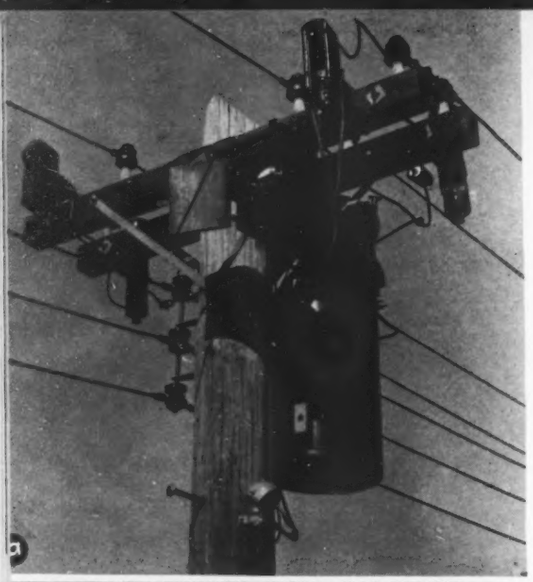
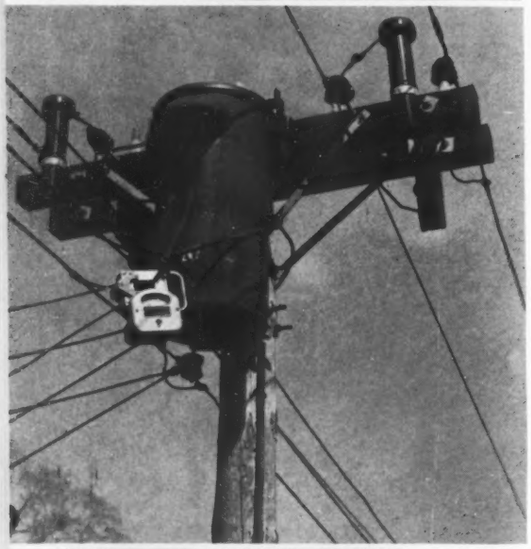
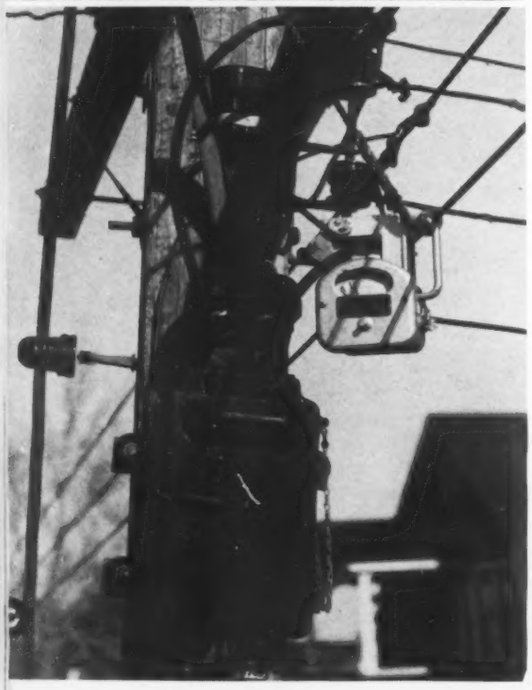


Fig. 2—Remote indication of hourly energy









Metered on either side of transformer

(a) Lincoln ampere demand meter installed on primary side of distribution transformer.
(b) Max-I-Meter on the secondary side of a distribution transformer.
(c) Max-I-Meter installed at end of transformer secondary terminal.

Load Surveys Avert

By K. L. PARTRIDGE
Distribution Engineer, Hartford Elecrtic Light Company

IN THIS era of rapidly growing distribution loads the use of various kinds of load-measuring devices is of vital importance to the efficient operation of a distribution system. Increased use of electric ranges, water heaters and other heavy-duty domestic appliances requires more knowledge concerning the characteristics of the domestic customer demands and load curve. This increased usage also requires closer supervision of distribution transformer loading, so that adequate capacity may be always available, and conversely, to see that we do not overstep ourselves and provide excess capacity and the consequent investment in unused kva.

Trend toward unattended substations requires recording load instruments at each substation, or remote load indication brought back to some central point, in order properly to supervise substation and feeder loads and operations.

Industrial and large commercial customers supplied from separate transformers or large secondary services require periodic load checks to see that proper and adequate service facilities are provided.

Policy of this company for many years has been to conduct a systematic annual load survey covering distribution transformers and industrial and large commercial customer installations. An outline of the procedure and methods follows.

Early in the fall of each year, the connected load on distribution transformers is gone over, and transformers which should be checked are listed. All transformers operating with secondaries banked are included, and such single transformers as appear heavily loaded.

Spot Checks—In past years, the actual load measurements have been performed at night between the hours of 6:00 and 8:00 p. m. for domestic areas, and between the hours of 4:30 and 6:00 p. m. for commercial areas. Testing started in the middle of October and continued until the first of the year.

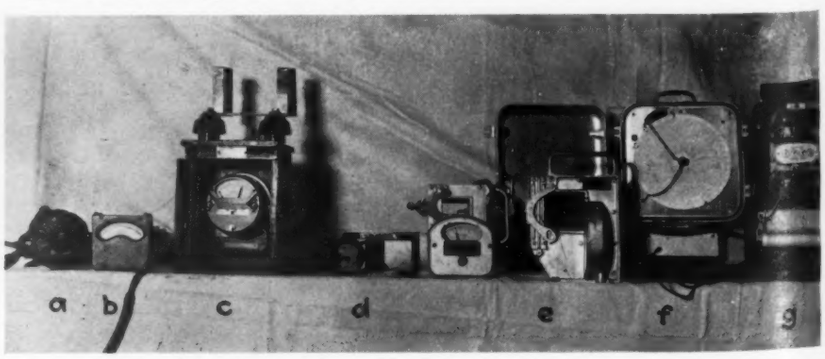
Test crews consisted of one instrument man and one lineman for overhead districts, and one instrument man and a splicer and his helper for underground areas. Split core transformers with remote connected ammeters, or the more modern split core transformers with self-contained ammeter, were used. All loads were measured on the secondary side, and were instantaneous.

These load readings were carefully checked in the office. Transformers found with serious overload conditions were immediately cared for, the remaining ones being taken care of in the normal routine. Finally, these test data are carefully filed for future reference.

It might be well to say here, that in the early days of the electric range, we found that some sort of a loading schedule was necessary to prevent serious overloading of transformers due to promiscuous

Battery of instruments for load surveying

(a) Split-core transformer with remote ammeter.
(b) Lincoln ampere-demand meter in weatherproof housing.
(c) Ferranti split-core transformer with self-contained Lincoln ampere-demand meter.
(d) Max-I-Meter—a split-core transformer with self-contained Lincoln ampere-demand meter.
(e) Split-core transformer with various ratios to go with (f).
(f) Lincoln recording ampere-demand meter.
(g) Westinghouse type RA recording demand meter.



Undue Loading and Excess Capacity

installation of ranges. Consequently such a loading schedule was developed which permitted us to change transformer sizes throughout the year as necessary to conform with changes in the connected load. This eliminated a large number of the transformer changes following the Annual Load Check.

As time went on and our range density increased to a sizable figure, these spot tests could not be relied upon to give an accurate indication of peak load on the transformer, since readings extended beyond the peak time. Consequently they were interpreted as base (lighting) load peaks, and range and water heater increments were estimated and added to these spot tests to give an estimated peak.

This was unsatisfactory, so a change in testing procedure was inaugurated to give actual half-hour demand indications.

Ampere demand meters adopted

Two types of Lincoln half-hour ampere demand instruments were selected; one which may be hung from the cross arm and connected in series with a primary leg of the transformer, the other consisting of a split core transformer with self-contained Lincoln ampere demand meter. This unit has various ratios, and was hung on the secondary leg of the transformer under test.

This method eliminated all overtime work, since the instruments could be removed and reinstalled during regular working hours. A lineman and groundman can handle approximately eighteen new test installations per day. Office analysis was simplified, since actual peak demand values were obtained.

In strictly underground commercial areas, where, in our case, the number of transformers is relatively small, the former method of spot testing was retained. These tests could be completed in the pre-holiday and holiday period.

In residential underground areas, the split core type self-contained Lincoln instrument was used, installing it on one secondary leg in each phase of the subway transformer.

Once a year industrial and large commercial customer loads are reviewed. A preliminary office survey is first made, noting billing demands, where available, reviewing previous load measurements, and any other data available, pertaining to load increases or decreases. A final test list is prepared for survey and turned over to the Testing Department for execution. This work is accomplished during November, December and January, unless the character of the load is such that peaks occur in some other season of the year.

For this particular phase of the load survey, recording instruments are used, since load factors on these types of customers vary widely. Two types are used, a Westinghouse half-hour graphic demand meter, and a Lincoln half-hour ampere demand graphic meter.

These charts are analyzed in the office, and such changes as are necessary are drawn up and executed.

A continuous check is maintained on feeder and substation loading. Reports are received each week showing the 2-hour peak load on all feeders and substations, throughout the system. These reports are obtained from log sheets in attended substations, and from graphic ammeters in the unattended substations. The peak for each month is selected from these reports, and set up in graphic form, showing ten years per sheet. This serves a dual purpose. It gives a quick visual means of checking system load conditions, and provides a means of load forecasting by extrapolation of these curves.

Each year various load investigations are made outside of the routine surveys. Load studies of various groups of domestic customers are made. This serves as a check on the configuration of the load curve of this type of customer, and is an aid to efficient transformer loading. Westinghouse half-hour graphic demand meters are preferred for this type of study. These meters are installed in a weatherproof housing and mounted directly on the transformer pole. Connection to the transformer is made through a proper current transformer connected in series with one primary lead of the transformer under test.

Since apartment houses equipped with electric ranges have different demand characteristics than ordinary domestic customers, studies have been made of various types of apartments to determine these characteristics. Here again the Westinghouse R.A. type demand meter is a useful tool.

Where metering installations permit and the results are satisfactory, demand registers have been added to these existing meters, to measure total demand established by the building.

Occasionally a knowledge of current distribution along overhead primaries, across a set of junction fuses or the load on a branch tap is necessary. Here the split core with self-contained Lincoln ampere demand meter is useful. This meter is simply hung over the primary wire at the desired point, and left as long as desired.

INDUSTRIAL ANALYZER A VERSATILE SURVEY TOOL

Another utility interprets "load surveys" to em brace those within industrial plants as well a on the utility's distribution system. Thus—

1. How many motors are so loaded and operated as to require change when the distribution is changed over from 3-wire 3-phase 230 volts to 4-wire 3-phase 208 volts? Also, afterwards, is there assurance that none of the changes have adversely affected the operation of the customer's equipment.

2. Starting loads, especially air conditioning motors, create flicker and impose peaks on the demand curve. Here, as in (1) the industrial analyzer detects the culprit motor and points to one with better starting characteristics.

3. Industrial users occasionally feel that the demand charges are to blame for rising electric bills. Based on tests with the Weston Industrial Analyzer recommendations are made toward more efficient motor application and more advantageous scheduling of intermittent loads.

4. Power sales engineers demonstrate to an industrial plant proprietor that purchased energy can save him more than his privately generated energy. The analyzer establishes the case before hand and proves it afterwards, especially the gains from more efficient allocation of his utilization equipment.

Load and Time Control Rely on System Instrumentation

By PAUL B. JUHNKE
Chief Load Dispatcher
Commonwealth Edison Company

ONE of the most actively discussed technical topics in electric power industry literature is that of frequency control and the associated tie-line load control. It occupies this position because of its very positive bearing on the economical operation of large interconnected systems. Of the two separate items, frequency control is the more basic, its attainment making tie-line control relatively easy.

Frequency Standards—Standards of frequency were rather slow to advance. When they did, it quickly resulted in definite action. In point of time this dates back ten to fifteen years, when serious consideration of higher standards was dictated by the wide acceptance of electric clocks and the growth of inter-connection between contiguous power systems. Up to that time there was really not much need for higher standards. Whether a system ran at 60 or 61 cycles did not have much significance and no one particularly cared about it. Frequency indicators reading in half cycles reflected a similar appraisal. This relatively low standard changed rapidly, when the public began to buy electric clocks in 10,000 lots and compared their performance with that of high-grade watches. There was then furnished an incentive.

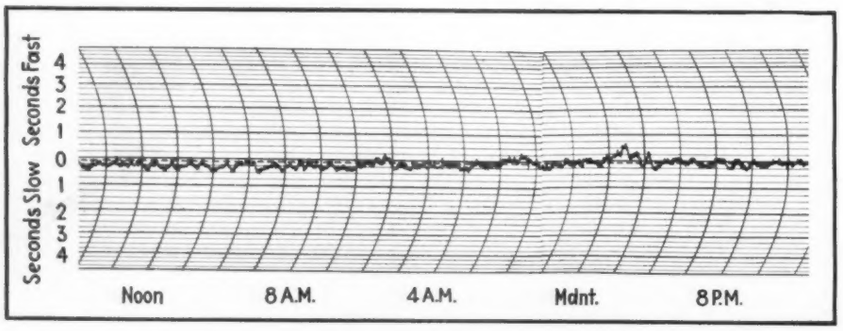
Frequency Indication — Manufacturers of instruments already had anticipated the probable demand. The new instruments were readily accepted to meet the situation as it had developed from without. Frequency instruments reading 1/20 and 1/40 cycle came into vogue, and they raised both prevailing standards and operators' appreciation for standards of the highest order.

This development in the art of instrumentation has made possible a refinement in frequency control that is truly remarkable. Isolated systems of 1,000,000 kw. and more are now regulated for days, with relatively little effort, to frequency variations of 1/20 cycle or less, while interconnected groups must necessarily recognize broader bands of tolerance.

Time Deviation Recorders—When precision frequency indicators came into use they paved the way for general acceptance of the time deviation instrument. Of course, the Warren clock was on hand twenty years ago, but general acceptance of it and similar devices for measuring deviation of electric time from astronomical time did not come about until the arrival of precision frequency meters. While observatory time is still the accepted standard, the crystal time regulator has made its appearance in electric power systems. With the aid of this instrument electric time deviation from true crystal-regulated time is measured in cycles, meaning sixtieths of seconds rather than seconds. It is the standard in one large system and the objective of many others.

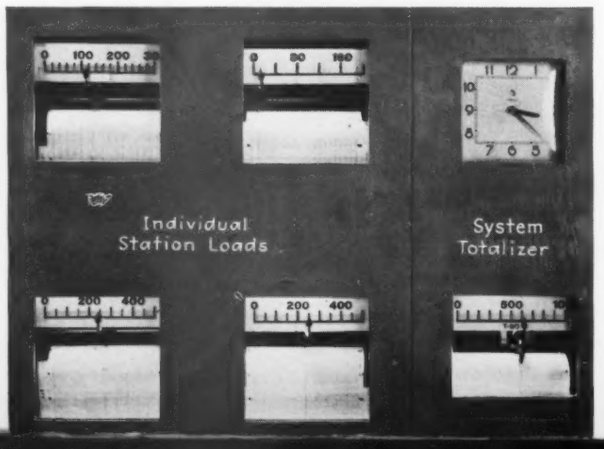
System Load Totalizer and Distributor—With such refined standards of frequency definitely accepted, there is next the load-totalizing instrument for integrated systems, the indications of which are accepted as the basis for most efficient distribution of load between the different generating stations on the system. Such an instrument is of major importance in the maintenance of desirable system frequency. The indication of the system load totalizer, located usually at a central dispatching point, when retransmitted to each generating station, is a further refinement, permitting immediate response to load changes and preventing uncalled for and unintended shifting of load between these stations, and thereby contributing further to the ease of maintenance of standard frequency. With such an installation each station has before it at all times the total of the system, which is supplemented by a load

Crystal oscillator regulates frequency accurately and holds time to small deviations



Totalizer is basis for efficient load allocation

Instantaneous picture of load change afforded to load dispatcher. Totalizer readings may be returned to each station; operators can then continuously adjust station loads to meet dispatching schedules, thereby contributing to most efficient load distribution with minimum of verbal direction on part of load dispatcher.



schedule showing that station's obligation toward the system for any value of the total load of the system.

In the offing there already looms up the automatic load distributor, which does automatically what the load dispatcher now has to do verbally. This instrument should do a creditable job after the load dispatcher or system operator has impressed upon it the operating schedule intended.

Tie-Line Control—The foregoing, however, covers only isolated systems. When a number of isolated systems are interconnected to form a regional system, such as the one extending from the coast of Florida to the shores of the Great Lakes, the problem of frequency control assumes a different aspect. Here fifty-odd operating systems are interconnected and maintain a reasonably high standard of frequency and time. However, this is not a closely knit organization. A purely co-operative effort here takes the place of the discipline of the isolated system. In such a regional system the task of many groups becomes one of tie-line control, pure and simple. Moreover, here the main regulating effort must be made by the largest individual organizations with ample capacity and size of interconnecting elements.

In such an interconnected group frequency regulation is carried out by two or three of the largest generating stations, suitably located—preferably centrally. Here automatic frequency regulators, with response to frequency departures somewhat retarded, direct the performance of the stations in question. This retardation is intended to prevent the unintended drift of load from one station to the other during the regulating effort.

Tie-Line Controller — Additional principal stations in different parts of the system in question share in the regulatory task, in response to instruments which are a combination of frequency regulator and tie-line controller. These are practically indispensable for systems aiming at precision in regulation.

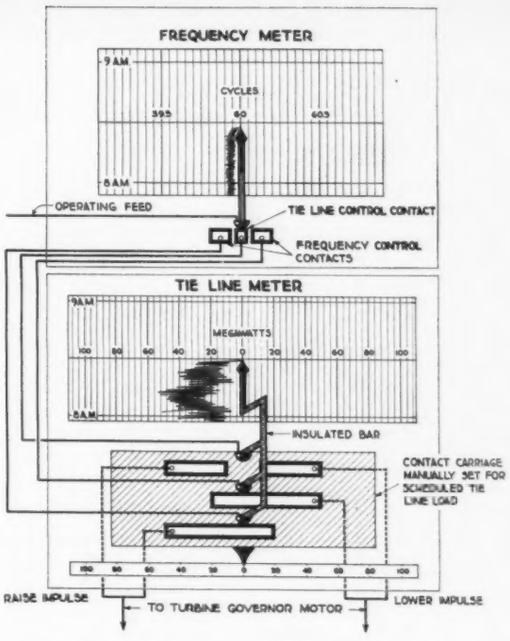
The following are the functions assigned to this instrument:

A station is delegated to participate in the regulating effort of such a system. To keep the tie-line at an agreed value a tie line controller is installed. The controller then operates to hold the station to a given tie-line load, which is entirely independent of its local load. However, it becomes necessary for the station in question to set apart some of its spare capacity for this purpose. With this provision, the performance of this instrument is very gratifying.

This tie-line controller (shown schematically) has an attachment which converts it into a frequency regulator whenever the system frequency departs from standard by a given amount, be it 1/40, 1/20, 1/10 cycle, etc., whichever is chosen. When such departure has occurred the frequency regulator attachment comes into play and permits the station to contribute to regulation by either pulling up or down, thereby departing from scheduled tie-line load by a predetermined amount—10,000 kw., 20,000 kw. or any other value—for which, of course, regulating range must be maintained with stops to guard against variations which may be considered unsafe.

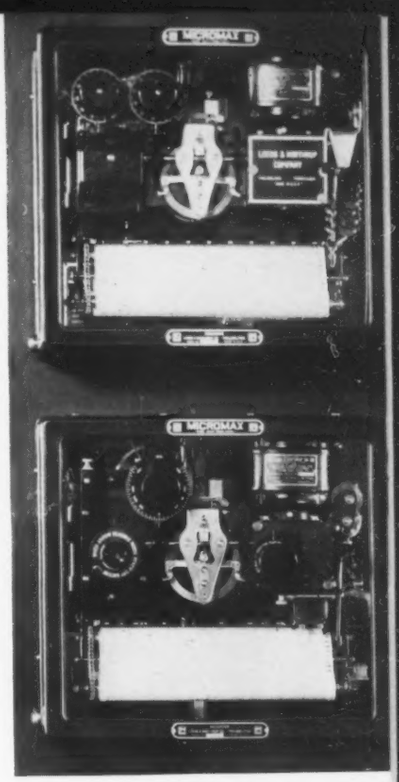
When more than one machine takes part in the task of regulation another device comes into play, the proportionate load divider. Whenever the regulating station performs, the pick-up or drop shall be so divided between the several machines assigned to regulating duty as to make the burden on the boiler room a minimum.

Still another attachment is the tie-line error counter, which may be made an adjunct to a tie-line connecting two systems.



Tie-line controller becomes frequency regulator on excess deviation

Holds tie-line within regulated band when frequency is within tolerance limits. Becomes frequency controller by varying tie-line load when frequency departs from tolerance limits.

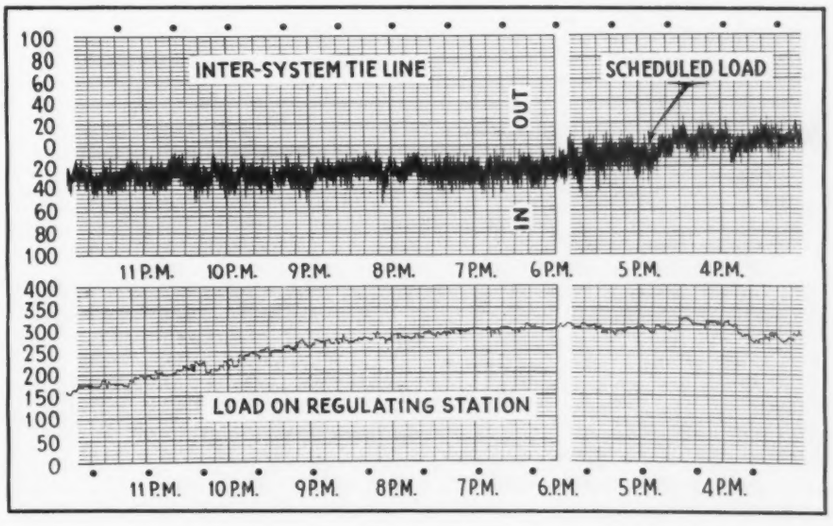


Tie-line controller aids key stations hold frequency

Upper meter—Generating station total load has minimum and maximum limit switches which may be changed by operator to meet system and tie-line requirements. Lower meter—Tie-line meter is set to the scheduled tie-line load.

Tie load held with small burden on regulating station

The result of modern instrumentation and automatic control applied to meter-system tie-line.



Conduction, Insulation and Equipment

By OTTO A. KNOPP

Chief Bureau of Tests and Inspection
Pacific Gas & Electric Company, Emeryville, Calif.

(a) Means of compensating for the effects of temperature change is sought. Because temperatures affected its capacitance, carrier-current telephone equipment gave trouble in a station. Oscillator at left, variable condenser and tapped transformer employed to discover the remedy.

(b) Operating-time curve plotted for Westinghouse type CR relay. Operator employs ammeter, rheostat and stop-watch to obtain the data. At operator's left is a second set-up for routine testing of a split-core current transformer which has been sent into the laboratory from the field. Immediately below the bench surface is the simulated line conductor supporting the transformer. Taps at the left allow wide variations in connected ampere turns, thus allowing use of the small range ammeter.

(c) Power testing equipment employed for testing underloaded and short-circuit conditions.

CONDUCTION and insulation in a power system are closely related. In order to transmit power from the generator, through the step-up transformers, transmission line, step-down transformers, distribution feeders and distribution transformers, to the customer, a high conductivity path, effectively guarded by proper insulation, must be constantly maintained, in order that loss of current be prevented and continuity of service guaranteed.

To achieve such maintenance impending weakness in the system must be discerned before failure occurs. Instruments make such discernment possible.

What constitutes adequate instrumentation for purposes of maintenance must be determined in part by the nature of the system. The Pacific Gas & Electric Company serves an area 500 miles long by 125 miles wide. It is divided into twelve divisions. Operating engineers are responsible for maintenance within each division, and in each division office are concentrated such instruments as are essential to routine or emergency testing. For special jobs, divisions call upon the laboratory, which has no jurisdiction over them, but functions in an advisory capacity and as a service agency. Expensive or special equipment is concentrated in this laboratory.

Equipment for use in the field is dispatched from the laboratory to whichever division needs it, along with a man to supervise its operation. Meggers are one exception to this plan because they are both valuable and in constant demand. (The system uses about 30.) Some five or ten are permanently assigned to large power stations. The rest are shifted from place to place wherever needed and their whereabouts are followed up in the general office by an operating engineer. The laboratory, besides several resistance bridges, has one high-grade megohmer for its own use and possible emergency use on the system.

While this is the set-up within one system, every system requires some

Maintenance Testing

corresponding balance between equipment for routine and for special tests, and for field or laboratory use.

Large companies are equipped to test line conductors and cables before installation for conductivity, using conductivity bridges such as, Hoopes conductivity bridges, Kelvin bridges and others. Tensile strengths of conductors are tested to insure proper hardness and elastic limit. Similarly, splices and connectors are tested for mechanical strength and conductivity.

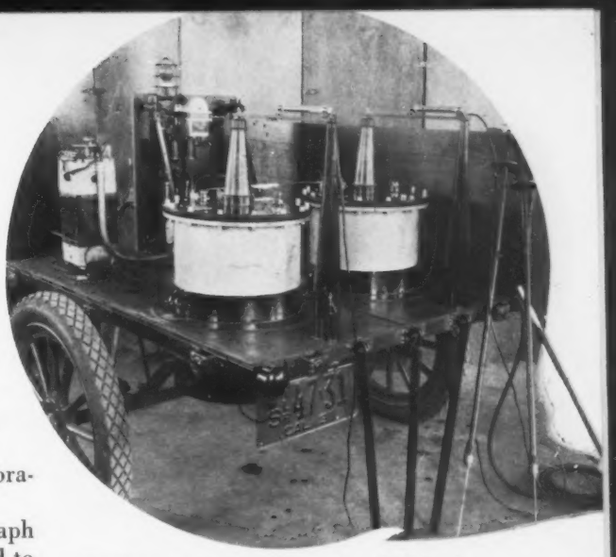
Since not only the conductance of the conductors affects the current flow but also the inductance and capacitance of the circuit, calculation of these factors must at times be checked in service, requiring considerable instrumentation in the way of instrument transformers, voltmeters, ammeters and wattmeters.

Vibration tests play an important part in preventing outages through conductor breakage. Field tests are employed to determine amplitude and period of vibration. This requires recording instruments for wind velocity, wind direction, amplitude and period of vibration.

Insulation of circuits requires by far the most attention and a large amount of instrumental equipment. This will be discussed in detail.

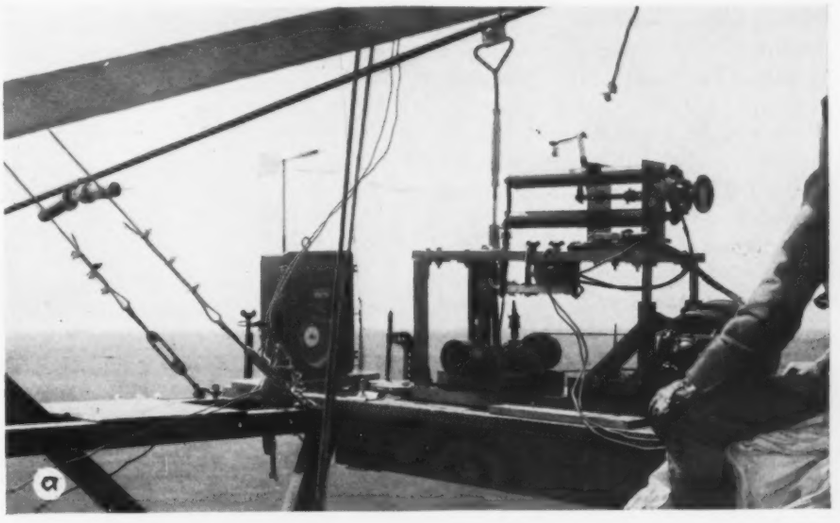
Rotating Equipment, Transformers and Bushings—Insulation of rotating equipment is watched by periodic measurements with a megger or megohmer, these being kept in the operating department, as already noted. Temperature indicating and recording instruments must be relied upon to give hot-spot temperatures in generators and transformers so that deterioration through excessive heat can be prevented. While these are a normal part of station equipment, the laboratory comes in for a maintenance job when new windings on the machines demand the construction and calibration of new thermocouples.

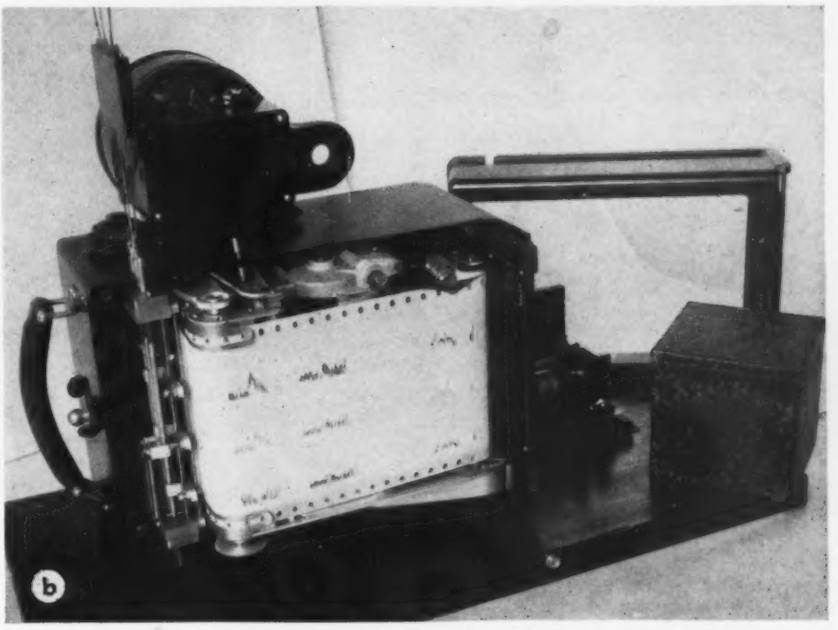
Peak voltmeters and klydonograph equipment are sometimes required to determine the maximum voltage stresses to which particular equipment is subjected under operating conditions. For instance, a station may wonder why insulation suddenly gives way. The foregoing equipment



Trailer-mounted equipment valuable in testing insulators

For field use where 110-volt service can be tapped. Trailer-mounted equipment valuable in testing insulators. Transformers are General Electric X-ray, 50,000 volts each, induction type regulator and switchboard are adjacent. Highly insulated terminal probes are provided to apply voltage between petticoats of the insulators.





Portable laboratory studies conductor vibration

(a) Installed atop a transmission tower, it will vibrate the conductors at any given frequency, recording wind velocity and direction and amplitude and frequency of vibration. Anemometer not shown.

(b) Recorder simultaneously charts amplitude and frequency of vibration of three transmission line conductors.

Oils are placed in the beakers within the vessel. Beakers contain coils, insulated like transformer coils, used to heat the oil. Motor-driven pump circulates air. Oil samples are later removed and quantity and quality of sludge determined. Temperatures are recorded by instrument.

Tests oils by reproducing conditions in the transformer

may save considerable trouble and expense through revealing unusual surges growing out of a certain sequence of switching operation.

High-voltage bushings are tested in up-to-date power companies by means of Schering power factor bridges* and dielectric loss-testing equipment.

Transformer oils must first be tested to see that they meet specifications for flash point, viscosity, neutralization number, acid content, free of corrosive sulphur. They must also meet requirements for sludge, dielectric strength, etc. In the field, the quality of oil is tested frequently by checking the dielectric strength. Divisions and large stations are equipped for this work, transformer and voltmeter being used in connection with oil cup and electrodes. This company refers oils which appear to be in bad condition to the laboratory, where complete tests are made to determine sludging quality.†

High-Voltage Underground Cable—Systematic testing usually begins at the cable factory, where instruments include dielectric loss-testing equipment as mentioned above, high-resistance bridges to determine resistance per mile, voltmeters and sphere gaps for measuring the strength of insulation samples. Several systems, particularly Eastern, report economies through the use of similar equipment.

Some companies are equipped to carry on considerable research. This, plus routine testing in laboratory and field, demands adequate instrumentation for its economic success. Involved are dielectric strength tests, dielectric loss tests, insulation resistance tests, load temperature tests conducted with equipment mentioned above and Kenotron cable test sets.

For fault location, the following equipment comes into use:

1. Loop or bridge testing equipment, such as the Decade set.
2. Capacity testing equipment, particularly useful on lines which have faulted but burned clear. This can consist, for instance of condensation and resistances used in conjunction with a voltmeter.
3. Interrupter and exploring-coil testing equipment.

Porcelain and Glass Insulators—Aside from equipment already mentioned, insulator testing involves the use of the polariscope for measuring physical internal strain in glass insulators, field strength meters to determine sources of radio interference, hot-stick testers in the field and high-voltage portable equipment to measure dielectric strength.

Linemen Protective Equipment—Protection of men who work on high-voltage circuits involves many rubber-insulating devices, such as gloves, hoods, sleeves, blankets, line hose, insulator hoods. This equipment must have its integrity verified frequently.

Such routine tests, as conducted in the laboratory, require a potential transformer and voltage regulator to supply the electricity used, voltmeter to measure its potential and milliammeter to measure leakage current. Thus the familiar dielectric or potential test can be carried out. Especially shaped electrodes to fit the surface of the rubber devices and tanks for water electrodes are also needed.

Acceptance tests are made on rubber equipment of new make or type to determine its suitability for purchase. Further instrumentation is required if tests are to proceed beyond this point. Tensile tests of rubber require special dies for cutting samples and a machine to measure their strength and elasticity. Accelerated aging requires an oxygen bomb or pressure vessels capable of holding rubber samples in oxygen gas at a pressure of 300 lb. per sq.in. and 70 deg. C. A pressure regulator, pressure gage and thermostatically controlled oven become necessary.

Another example is the routine testing of insulators in the field. The determination and elimination of faulty units prevents expensive outages and repairs and improves customer relations.

The foregoing outlines the major categories of maintenance instrumentation. When we consider that system deterioration is largely undiscernible directly, through sight, hearing or other senses, we get a new appreciation of the extent to which we depend on instruments for the rendering of uninterrupted service.

INDIRECT GAINS CARRY THE OUTLAY FOR INSTRUMENTATION

JUST as an acceptance test means more conductivity and more insulation per dollar spent, so maintenance testing means more service per dollar invested. Any point in the system might be selected as an example of the wisdom and economy of protection through instruments. Consider the sludging of transformer oil. Simple instrumentation will detect sludging before it becomes objectionable, will prevent transformers overheating. When these reduced temperatures are translated into terms of ability to carry more load, or into available transformer capacity, the saving in dollars becomes large indeed.

* C. J. Benham, ELECTRICAL WORLD, September 28, 1935, and Gross and Turner, ELECTRICAL WORLD, January 13, 1934.

† *Electrical West*, October, 1934, "Sludging Formation in Insulating Oils."

Balanced Load Building Aids System Factor

Use of existing loads as guide to new business reflected in annual load factor of 61.6 per cent

By R. C. McFADDEN

New-Business Manager, Southern California Edison Company, Los Angeles, Calif.

IT HAS been our aim continually to carry on a well-balanced load-building program rather than to specialize too highly on any single class of load. That such a plan has produced some measure of success is evidenced by the fact that the Edison company's annual load factor is 61.6 per cent. There is still a great deal to be done in the acquiring of new loads, but in every instance consideration as to their desirability, both from a rate standpoint and from the standpoint of how well these loads dovetail in with existing business, will be given before too much sales effort is expended.

The commercial and industrial business of the Southern California Edison Company covers a very wide diversity of use, as may be seen from the following general breakdown of total of such sales for 1937:

Agricultural power	391,098,810 kw.-hr.
General industrial power	624,308,287 kw.-hr.
Oil industry	306,564,207 kw.-hr.
Railways	267,013,071 kw.-hr.
Cement industry	94,264,700 kw.-hr.
Wholesale	94,299,909 kw.-hr.
Municipal lighting	12,436,814 kw.-hr.
Municipal power	79,204,015 kw.-hr.
Commercial and industrial lighting	156,342,924 kw.-hr.
Street lighting	40,106,358 kw.-hr.
Total sales	2,065,639,095 kw.-hr.

In order to carry on a balanced load-building program it is necessary, of course, to stimulate, in so far as it is possible, new loads and uses among these many general classifications, and to do this the commercial and industrial power sales organization, which we call the new-business department, has been developed. It is to be noted that sales to residential consumers are not included in this article. It is, of course, the function of this department not only to secure new business but also to retain against competition and loss such business as has already been connected to the lines. Inasmuch as several of the types of load above referred to lend themselves to specialized load promotion, it has been found desirable to develop special sales groups to concentrate on these activities, and in the following organization chart the extent to which specialized selling is carried on is shown.

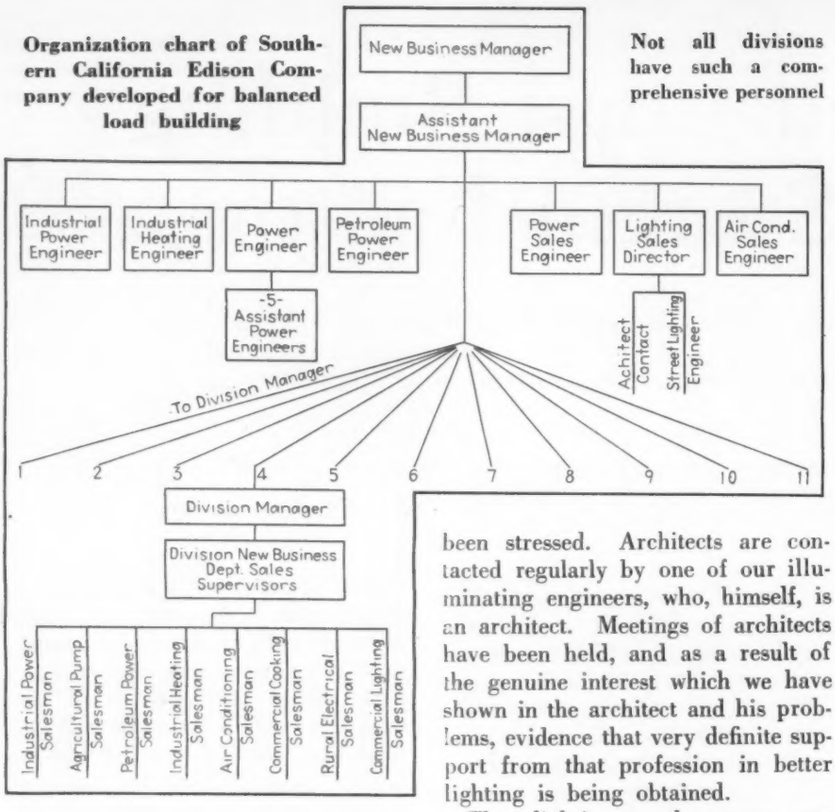
R. C. McFadden

The prime function of the general office staff is that of organization, sales planning, budgeting, preparation of sales helps and assisting on specialized sales problems, while the responsibility for the carrying out of the sales program is definitely placed in the hands of the respective division organizations. While the chart shows the typical division organization, yet it does not necessarily mean that each of our operating divisions includes such a comprehensive sales personnel. The sales opportunities in each division, of course, are carefully analyzed and the individual sales staff is built around the requirements of the particular division. The complete division sales organization of the company consists of the following groups of men: Division supervisors, 9; commercial and industrial lighting salesmen, 19; agricultural pumping salesmen, 12; general power salesmen, 11; oil industry power salesmen, 7; rural electrification salesmen, 10; air conditioning salesmen, 2; industrial heating salesmen, 1; commercial cooking salesmen, 8.

Definite detailed objectives

In the preparation of sales budgets and quotas definite budgets and objectives are established for each of these sales groups and, of course, definite sales plans are formulated for each activity. These budgets are then broken down and to each division is assigned a proper proportion of the total, this proportion being based, of course, on the potential load development possibilities in that particular division. For 1937 the following horsepower load budgets were established and oppo-

Organization chart of Southern California Edison Company developed for balanced load building



Not all divisions have such a comprehensive personnel

site each is to be noted the accomplishment for the year:

Type of Load	1937 Budget, Hp.	New Load Secured During 1937, Hp.
Commercial and industrial lighting..	25,400	26,700
Street lighting	600	600
Agricultural pumping	16,000	27,000
* Miscellaneous agricultural power..	8,600	5,500
Air conditioning...	3,000	2,900
Industrial power ..	47,400	56,000
Petroleum industry power	9,600	12,100
Industrial heating..	8,700	8,400
Commercial cooking.	4,400	5,000
Total	123,700	141,200

* In this classification fall all forms of farm power uses exclusive of pumping loads.

In general, our sales program is one of sales promotion in which no equipment is sold, the only exception being with respect to commercial cooking.

Add 37 kw. per month of commercial lighting

In our commercial and industrial lighting promotional selling we employ practically every approved method of advancing a greater and more generous use of illumination.

In advertising both direct mail and newspapers are used. Speakers are ready at all times to present the "Better Light-Better Sight" story. School lighting demonstrations have been made, employing tube controls. Outdoor recreation installations have been stressed. Architects are contacted regularly by one of our illuminating engineers, who, himself, is an architect. Meetings of architects have been held, and as a result of the genuine interest which we have shown in the architect and his problems, evidence that very definite support from that profession in better lighting is being obtained.

The lighting salesmen are equipped with numerous sales tools such as foot-candle meters, demonstration kits and extension demonstrator units both for interior use as well as for floodlighting. A very careful check on the creative work of these men is kept and we are definitely able to credit their individual sales efforts with an average of 37 kw. of new load monthly. When this added load is multiplied by its own revenue value, there can be no argument as to the value of the promotional lighting salesman.

The general power, agricultural pumping and oil industry group of salesmen are in a great measure concerned with competition. Because we are serving exclusively a territory with electric energy, it does not follow that we automatically obtain all of the new business that develops or that all of our existing business stays with us forever. In my opinion one of the most important functions of the new-business department is that of holding existing business. Our competition has been very general in character. However, due to the widespread distribution of natural gas in our territory that fuel has greatly overshadowed Diesel as a serious contender. An increasing number of steam and process heat industries are locating in southern California, consequently competition from steam generation has taxed our ingenuity to a very considerable extent.

In the agricultural pumping field we have always had gas engine problems, but with the low level of present electric rates little, if any, advantage in gas operation can be shown. How well this understanding has been sold to prospective consumers is evidenced by the fact that almost, without exception, every new well drilled in Edison territory in recent years has been electrically equipped.

Competition in a somewhat new form has developed in our territory during the last year among the heavy commercial lighting group of consumers. The advocates of private plant operation have been advancing, so far with but meager success, the installation of gas engine generators. It is to be expected that some installations of this character will be sold; however, out of an exhaustive study of the problem has developed a rather complete knowledge of the competition being faced, with the result that not too much concern is being felt over the eventual outcome. More than one-half of all such installations have already failed in operation and have been removed, many of the failures occurring within a relatively short time after installation. In the case of those installations which have not been removed, we are continually learning of plant failures with attendant service interruptions, and it is only a matter of time before the operators of these plants will give up in desperation and confess that their experiment has not been a success.

Commercial cooking is somewhat of a baby among our sales promotion activities; however, excellent load-building opportunities exist, and the annual revenue which this type of load produces is forcing genuine recognition, as has been shown in ELECTRICAL WORLD, March 12, 1938, page 51.

Farm loads far from saturation

In spite of the fact that California ranks close to the top of the nation in the number of electrified farms and that we are prone to consider rural electrification at its peak with us, yet we have found that our farms are far from saturated with respect to the further use of electricity.

We have, as the organization chart

shows, a staff of eleven men devoting their time to the development of this saturation business, much of which comes in the form of electric incubation and brooders, dairy loads of all kinds, soil and greenhouse heating, etc. In building this sales group we have endeavored to obtain men who either are agricultural college graduates or who have had a farm background plus a good fundamental education.

It has been our practice to send these men to the Rural Electric Short Course held annually at Davis, Calif., under the auspices of the University of California. The benefits to our organization from the instruction obtained from this school, we feel, are invaluable. In the promotion of these various farm loads we co-operate with local dealers and distributors of equipment, and as a result of the organization of the department a number of strong dealers in electric farm equipment have established themselves. We also find that many others who in the past were somewhat "lukewarm" are now actively pushing electrical sales. We think that our kind of rural electrification pays dividends—not only in added revenue but also in good will and better understanding between our company and our consumers.

Due to the comparatively temperate climate that prevails over the majority of Southern California Edison territory, air conditioning has probably received less attention to date than any class of load for which quotas are established; however, with a better understanding of air conditioning on the part of the public, and to some degree with improved and more standardized equipment available, it is obvious that air conditioning will form a very important load and one that merits a much greater promotional effort.

At the present time two field men are devoting full time to air conditioning. Their work is in the nature of promotion, advising consumers as to their needs, and checking air conditioning proposals submitted by various agencies. In this manner we are able to originate the desire for air conditioning and to assure the purchaser that the proposed plant will adequately furnish the anticipated results.

Refrigeration Builds Commercial Loads

By G. D. WEATHERBEE
Commonwealth Edison Company, Chicago.

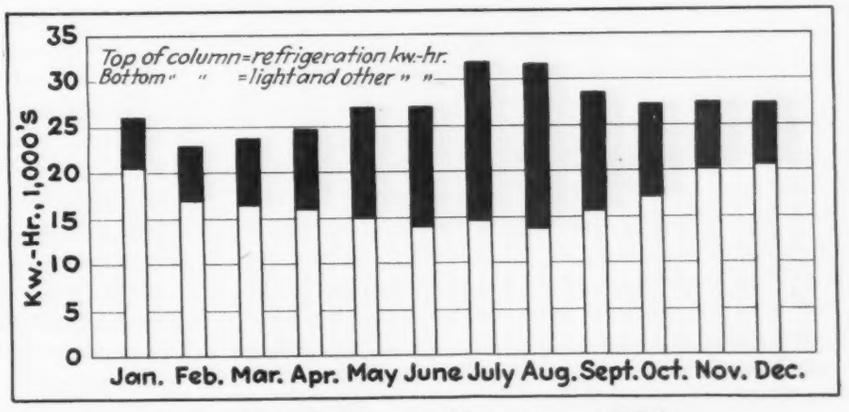
Commercial refrigeration in small shops and stores, while apparently widely applied, has not as yet been developed to its true value in terms of service to the customer and of load desirability to the power company. In Chicago there are about 125,000 small commercial establishments, of which one-fifth are businesses that need refrigeration, and of these a total of around 15,000 now have refrigerator installations. Almost all of these are inadequately equipped and might enlarge their installations 50 per cent or more. The present 15,000 customers average 2,800 kw.-hr. per year for refrigeration, 42,000,000 kw.-hr. for the group.

There can be no shut-down for commercial refrigeration; cessation for even a few hours may mean loss equivalent to a week's profit for a food merchant. The daily, monthly and annual load factors are all excellent. From a year's record of monthly readings of 43 meters installed for the study of small commercial refrigeration by the Commonwealth Edison Company it appears that this business has desirable summer load characteristics. The graph shows that although other use of electricity declines in the summer months refrigeration transforms them into peak months for the small food merchant. As examples of unusual cases, one unheated meat market used no electricity for refrigeration in January, but more than 800 kw.-hr. in August, but a florist with a well-heated store used practically the same energy for refrigeration during each of the twelve months. In general, the groceries and meat markets showed the greatest seasonal fluctuation for refrigeration; the restaurant jobs the least.

Sizes of the refrigeration motors covered by the study varied from 1/3 to 1½ hp. and the stores where they were working were a typical assortment of meat markets, delicatessens, groceries, restaurants, taverns and florists to obtain a characteristic cross-section of this type of business. A summary of the study appears in the following tabulation:

Number of stores studied	43
Number of refrigeration motors	45
Combined kw. of motors	43.42
Combined kw.-hr. for a year	121,768
Average kw.-hr. per store per year	2,830
Average kw.-hr. per kw. per year	2,800
Total kw.-hr. per year of 43 stores for all purposes	326,365
Ratio refrigeration kw.-hr. to total kw.-hr., per cent	37.3

The outstanding fact disclosed by the survey was that 2,800 kw.-hr. were sold annually for each kilowatt of connected load. This is a higher usage than any other distinctive load on the company's lines, hence the necessity for active promotion of this type of business is obvious.



Seasonal balance between refrigeration and lighting

This graph shows the monthly energy uses of 43 small commercial establishments in Chicago. The lower parts of the columns show energy used for lighting, while the top parts indicate the amounts of energy used for refrigeration. Note the decided summer peak.

Editorials

S. B. WILLIAMS, Editor

The Executives of Tomorrow

WEEK before last more than two hundred young men, all under 35 years of age and employed by Indiana electric utilities, met in Indianapolis for the first state-wide conference of its kind. The suggestion originated with three young men in the employ of the Indianapolis Power & Light Company. H. T. Pritchard, president of that company, turned the suggestion over to the Indiana Electric Association, which sponsored it for the state. The young men, from whom will come many of the future executives of Indiana properties, wanted to know more about the business in which they worked and what the future held out for them. The program of this first conference was planned from suggestions from these young men. It was a broad policy background program.

This meeting was in the nature of an experiment. That it was a success is perhaps best indicated by the fact that it is proposed to make it an annual affair.

Organizations of this kind, under the auspices of state associations, hold large possibilities for the industry. It won't be long before many of these men will have to be struggling with executive problems. The present is none too soon to begin thinking about them. And if they are to furnish the future leaders they ought to know what is expected of them and what they can expect of the industry.

Machines can be made more and more efficient and they can be made automatic, but the success of a utility company hangs not on them, but upon the men who guide it. Where problems used to be largely local they are now becoming more national. For that reason a broader training and perspective is needed for management.

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The Problem of Time Payment Delinquency

TIME payment delinquency is increasing, with the result that dealers in electrical appliances are becoming pinched. This presents a problem that directly affects the utilities. If the dealer repossesses the appliances the utility loses the load and the dealer in the meanwhile will spend his time trying to sell the used appliances instead of getting in a new stock.

How much is the load worth to the utility, especially where a major appliance such as a range or water heater is involved? Is the load worth guaranteeing the dealer's paper? Certainly if the dealer is relieved of the embarrassment of frozen credit he can continue to build load for the power company.

The delinquents were good credit risks when the sale was made. They are now in trouble, which in nine cases out of ten is only temporary. Before long they will be able to resume payments. In the meantime they are paying for increased electric service. It would seem like good business to protect this load.

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Forced Free Lamp Renewals Illegal

LITTLE time was lost by the Supreme Judicial Court of Massachusetts in declaring a "free lamp" bill recently submitted by the House of Representatives illegal. Since the Bay State commission put its disapproval on free lamps (even if allegedly covered in energy rates) ambitious politicians unsuccessfully have sought to restore the practice by introducing bills to that effect at each session of the Legislature. The utilities have been obliged to fight against these proposals and bear the onus of opposing that which passed among the unthinking as rightfully belonging to the people. In Massachusetts the annual appearance of this propaganda had become a first-class nuisance, of which the court now seems to have rid the commonwealth.

It is not surprising that the opinion (House Document 1389) sharply focussed the court's judgment upon the unconstitutionality of the bill. If such a bill were held valid all sorts of equipment, fixtures, wiring, refrigerators, washers, motors for industrial and other sevice—a whole gamut of items—could legally be required to be furnished free by electric companies. The due process clause would be violated by its passage and utilities would be compelled to provide a service not necessarily related to the function of supplying electricity to consumers. The legislative right to amend or repeal corporate charters does not go so far as to authorize taking the property and devoting it to a different use. Such a procedure would divert the capital into a different type of business and force it to assume risks foreign to those in which the stockholders consented to engage at the outset. Nay, more, the majority of the court held that this limitation as to property taking cannot be avoided even on the theory that the company may receive adequate compensation through rates. The bill in question made no such provision, but even if it had the proposed law would still be illegal.

The opinion contributes toward equitable trade

relations by keeping the lamp market wide open to vendors. It estops discrimination in lamp distribution by facilitating competition in retail sales, helps maintain quality—a matter of enormous, though none too well appreciated, importance in popular thinking—and is in line with current trends toward making every class of service carry its own economic weight.

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The Thomson Museum

RESTORATION of the office used for nearly three decades by the late Elihu Thomson at the West Lynn Works of the General Electric Company for future use as a museum is a fitting tribute to the great inventor-scientist. While "The Professor's" fame needs no local habitation for its perpetuation, it is an enrichment of life to recapture in part at least the setting in which events of such fundamental importance to the world took place, and posterity will be thankful for the preservation of relics and mementoes together at the very core of their inception.

Mass production has partially screened the comparative youthfulness of the electrical art, with its present far-flung distribution throughout the world of men. The myriad applications of electrical invention are the highest tribute to their value; but museums of this sort are oases in the turmoil of today to which both laymen and engineers may turn for refreshment as to an altar raised and maintained in honor of the spirit of scientific truth.

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National Promotion for Electrical Cookery

THIS MONTH marks another milestone in co-operation in the electrical industry. In the April issues Modern Kitchen Bureau program and now national electric range advertising. Utilities and dealers have advertised locally and certain manufacturers have publicized their products nationally, and now there is a national co-operative program promoting electric cooking.

This program is all the more significant because the money was appropriated by the manufacturers last fall when it took more than ordinary courage to start on a new sales promotion venture. Better Light-Better Sight was born in the bottom of the depression and has lifted the lighting industry to new business peaks and created a new business horizon. Is this electric range advertising that is starting virtually at the bottom of this business recession going to start electric range sales off to new peaks?

The answer lies in the action taken by the local electrical industry, particularly the utilities. After all, the manufacturers are not philanthropists. Next fall, when it is time to discuss an advertising appropriation for another year, they will want to know what the results have been. Have the sales reflected the money spent in this national advertising?

Even in this year of reduced employment and lower family incomes electric range sales can be pushed to higher levels (as lighting sales were five years ago, when conditions were much worse) by strong local efforts that are co-ordinated with the national promotion. We have low cooking rates, redesigned speedy and moderately priced ranges, lower wiring costs, a Modern Kitchen Bureau program and now national promotion. All that is needed now is strong local tie-in by the utilities to make 1938 a record electric range year.

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Advertising, Publicity and Propaganda

THERE seems to be a feeling on the part of a few public service commissions that their job is to bedevil the utilities they regulate. A recent case is that of Wisconsin, where the commission, through questionnaires, has collected from the utilities under its jurisdiction figures on advertising and publicity expenditures. However, in its press release it announced an investigation into the cost of "Wisconsin utility propaganda."

While the commission has not released any information on the results of the questionnaire, the membership of the Wisconsin Utilities Association, which supplies more than 90 per cent of the electric and gas service sold by companies in the state, spent less than 1 per cent of their aggregate gross revenues for advertising and publicity in 1937. Any business man knows that that is a woefully small amount to spend for that purpose.

Moreover, the bulk of the money is spent to build sales. Is that propaganda? Is that contrary to the public interest?

Some of the money was spent to build public good will and confidence, to prevent competition and destruction of investment values. Sure, that's propaganda, but if it's wrong, then the entire system of American publicity is wrong and, worst of all, the government.

Propaganda that is aimed to deceive is wrong, but propaganda that tells the truth is definitely in the public interest. Any state commission that believes its purpose in life is to hamstring utilities, while allowing any one and every one to try to undermine them with deceitful propaganda, is untrue to its trust. Public service commissions are set up not only to protect the interests of consumers but of investors as well. Publicity that creates good customer relations not only benefits the investor but, by making future financing easier, benefits the consumer in rates and in service as well.

The TVA Jury Record

By CARTER FIELD

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him

MARK TWAIN didn't think much of the jury system. Only a nitwit, he thought, could qualify for service, for merely to have read a newspaper account of the case was sufficient to disqualify.

For the first time in memory this theory has been attempted in a congressional investigation. Only men who have passed mentally unscathed through debate after debate, those who have been impervious to columns of impassioned *ex parte* pleading—in fact, only men who have voted for or against appropriations, amendments to bills and for or against investigations without bothering to find out what they were all about—could qualify.

It has never been done before. Always in the past the senator or representative who raised so much cain about some issue that an investigation was finally ordered was assured of a place on the committee. Even if he were of the minority party. If he were a member of the majority party he normally would be made chairman of the committee.

For instance the Senate investigation of Harry L. Dougherty. The Republicans were in control of the Senate, but the fuss had been kicked up mostly by a Democrat, Senator Burton K. Wheeler of Montana. He was put on the committee, though of course a senator wearing the Republican label was made chairman.

Can you remember that chairman's name? It was the Wheeler investigation from that moment.

The same logic, which worked so well with Wheeler, and equally well in Teapot Dome with the late Senator Thomas J. Walsh (he was a Democrat and the Republicans controlled the Senate at the time), should have dictated the appointment of two men, one of them Senator H. Styles Bridges of New Hampshire and the other Representative Andrew J. May of Kentucky.

Why? Because they *are* prejudiced. They *are* interested. Certainly other men to counteract them should be added to the committee, but after all a congressional inquiry is scarcely a cold, judicial function. It is a probe. Relentless digging is needed, as Walsh and Wheeler proved in their investigations. But let's look at the list:

Senators

Senator Vic Donahey (D), Ohio—Independent as the proverbial hog on ice. Made himself a powerful figure in Ohio while state auditor, while James M. Cox was governor. Used lots of publicity tricks. For example, forced a state judge to itemize a dinner on an expense account, and then disallowed a 35 cent charge for potatoes. "Not while the farmers of Ohio are only getting 65 cents a bushel," he told the newspapers. Months later he quietly approved the expense account. No publicity then. So the farmers thought he was like Calvin Coolidge. In fact, they voted for him, on the Democratic ticket, for governor, in 1924—he had been first elected in 1922—176,842 majority, although on the same day they gave Coolidge, Republican candidate for President, 698,242, probably the most spectacular instance of a man running ahead of his ticket in the entire political history of the U. S.

But he was *not* for Roosevelt at Chicago in 1932. So Roosevelt and Farley did not trust him. They persuaded Charles West, then occupying a seat in the House from a safely Democratic district, to run against Donahey in the Democratic primary in 1934. Donahey beat West easily, and in the ensuing election carried every one of the 22 congressional districts in the state. Donahey continued silent—he has yet to make his first speech in the upper house despite the reported verbosity of senators—but at Philadelphia he refused to make a speech seconding Roosevelt's nomination, despite Farley's impassioned pleas, overheard by half a dozen gaping Buckeye delegates.

Donahey happens to have been impressed by Dr. Arthur E. Morgan, though, despite published reports, they have met only casually. He knows what the voters of Ohio think of the Miami Conservancy District. He doesn't like the utilities much, but Morgan is not apt to get a raw deal. Donahey is unpredictable. He may take a keen interest in the investigation or he may almost ignore it. But even in the latter case an attempt of the committee to harass Morgan too much is apt to produce real interest. and then fireworks. Donahey knows his headlines—and his public.

Senator Fred H. Brown (D), New Hampshire—Exceeded by none in his slavish following of each and every White House wish. Also actuated by a distinct anti-utility slant. Was a member of the N. H. Public Service Commission before coming to the Senate, and has become, following Roosevelt, almost a utility baitor. Is up for re-election this year, and thinks that only being 100 per cent for FDR plus a revival of business in his state can save his political scalp. In fact, his confidence is at a very low ebb.

Senator H. H. Schwartz (D), Wyoming—Went to Wyoming in 1910, after making an excellent record in the famous land fraud cases while working for the General Land Office. Has been fairly successful in the oil business since. Ran for senator in 1930 on the wet ticket. but was a little ahead of his time. Actually elected in 1936. Thinks he owes everything to Roosevelt, and is intensely loyal to White House. Despite which Roosevelt train visit right after his colleague, Joe O'Mahoney, revolted on the Supreme Court issue was embarrassing. O'Mahoney joined the train, uninvited. Mrs. Roosevelt

[*Continued on page 142*]

News OF THE WEEK

New Jersey Public Service Plans Raising $10,000,000 New Capital

McCarter said funds will be needed for new construction — Higher taxes and operating expenses cut earnings — Dividend rate on common stock to be reduced — Outlook is good when business improves

Public Service Corporation of New Jersey plans $10,000,000 of new financing this year to meet capital expenditures, Thomas N. McCarter, president, told stockholders this week at their annual meeting. He stated that while construction expenditures are being held to minimum requirements, at least $10,000,000 of new capital will be needed before the end of the year.

Reviewing business conditions so far this year, Mr. McCarter said that the drop in earnings and the increase in operating expenses means that the company will be forced to reduce common dividends. Dividends will not be less than $2 and not above $2.40 a share, he declared. Last year the company paid $2.60 a share.

Outlook not so good

The outlook for 1938 is not so good, Mr. McCarter said. "We are in the midst of another serious depression and it seems that it is hitting the utility business more so than the last one." He stated that while there has been a healthy increase in residential load, a fair increase in commercial and some increase in public lighting, there has been a serious loss of the industrial load.

In analyzing power use Mr. McCarter pointed out that for the first three months of this year wholesale power sales were off 16.33 per cent, but increases of 8.6 per cent were shown in residential use, 1.49 per cent in commercial and 3.05 per cent in street lighting. He said that net income was about $1,440,000 under the first three months of last year.

Mr. McCarter declared that it is estimated that if the House tax bill stands taxes of the company will be increased $1,000,000 and under the Senate bill the increase will be approximately $1,500,000. Taxes for 1938 will approximate $24,000,000. The increase in taxes, higher wages and operating costs, including fuel, all translate themselves in less earnings to the stockholders, Mr. McCarter said. "We will have to cut the dividend some," adding that "we have had to cut dividends before, but there are good times coming when business gets good."

It was revealed by Mr. McCarter that in the past two years the company has added 168 new power customers. The company is completing the 50,000-kw. generating unit, which will go on the line in June. Another large unit had been contemplated, but it is now being held up.

Mr. McCarter said that no wage cuts had been contemplated. He said that the company has gone through other depressions and was now fully earning interest and dividends. He said that he saw a bright outlook for the company when business turned up.

William Scheerer, Edmund W. Wakelee, Edward C. Rose and George H. Blake were re-elected directors for a term of three years.

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Commission Orders Rate Discriminations Removed

The Federal Power Commission ordered the Gulf States Utilities Company on March 28 to remove within 30 days the undue discriminations found by the commission to exist in rate schedules under which five of the company's wholesale customers are served.

The commission's action follows its order of February 15 directing the company to show cause on or before March 16 why a certain one of its rate schedules which would effect savings should not be applied for electric energy sold to the communities of Abbeville, Broussard, and Erath, La., the Louisiana Power & Light Company and the Gulf Public Service Company. The order states that if the company fails to remove the discrimination within 30 days the order to show cause dated February 15 "shall not be deemed to have been satisfied."

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Carlisle Sees Bright Future for Utilities

Optimism over the future of the electric light and power industry was expressed by Floyd L. Carlisle, chairman of Niagara Hudson Power, at the annual meeting of stockholders last week.

"I want to say to you people as stockholders that I do not believe for one moment that this industry is going to cease to make money or fail to perform the functions for which it was set up," Mr. Carlisle said.

"I look forward with very great optimism to the prosperity and stability of the power business, and when we solve the question of unemployment the burden of taxation in relation to this business and other business will lessen."

It was pointed out by Mr. Carlisle that the electric business is so vital and its requirements of capital so great that the differences between the government and the industry will be solved. "They must be solved," he said, "or there can be no permanence to the recovery in this country."

Alfred Schoellkopf, president, stated that power output had fallen since the depression set in last year, but in recent weeks there had been a stabilization in the demand for electricity.

Earnings for the first quarter were below a year ago, with estimates about 25 cents a common share, a figure which Mr. Schoellkopf considered not conservative but high. In the first quarter last year the company earned 32 cents a share.

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Texas Project Must Have FPC License

FPC has issued a finding that the interests of interstate or foreign commerce would be affected by the proposed construction of the Possum Kingdom project on the Brazos River in Palo Pinto County, Texas, by the Brazos River Conservation and Reclamation District. The finding makes mandatory a FPC license for the proposed development, application for which has already been filed with the commission.

The proposed project, which is located approximately 75 miles west of Fort Worth, will include a power house with an initial installation of not less than 10,000 kw., provision to be made for the possible installation of additional units to raise the plant's capacity to 30,000 kw.

Brazos District intends to construct as rapidly as its finances and resources will permit a flood control system of thirteen dams. Power may be developed at four or five of these dams. The plan is an outgrowth of years of studying a means to battle the severe droughts and floods which have long ravaged the area. The district states that it does not intend to construct either substations or transmission lines for the distribution of electric energy generated at Possum Kingdom.

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Signs with CIO Unit

West Penn Power Company has signed a contract with the Utility Workers Organizing Committee, CIO affiliate, to replace the one expiring May 1. The agreement carries a provision that there will be no cuts in pay rates during the life of the new contract, which will run to May 1, 1939. The contract also provides a dues checkoff system.

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Davis on TVA Inquiry Board

Senator James J. Davis, Rep., Pa., has been named to complete the joint Senate and House committee to investigate the activities of the Tennessee Valley Authority.

Fluorescence Produces Tint Tone Lighting with High Efficiency

Powdered compounds fluoresce and convert invisible ultra-violet radiation to visible rays — New lamp promises to revolutionize methods of architectural lighting

Fluorescence officially became a new tool of lighting at an outstanding meeting held in New York on April 21, 1938, for the specific purpose of making the announcement. The new "fluorescent lumiline" lamps are of immediate and primary significance to architectural and ornamental lighting.

The various compounds employed in the tubes produce almost any desired tint and at efficiencies that in most instances outstrip the tungsten filament lamp when employed for similar color output. In fact, the same energy input produces 120 times as much light of one particular color as does a tungsten lamp controlled to produce the same color.

The announcement of the perfection and availability of the lamps was made by Ward Harrison, engineering director of the incandescent lamp department of the General Electric Company at Cleveland. He told of their characteristics and was followed by Samuel G. Hibben of the Westinghouse Lamp Company, Bloomfield, N. J., who outlined the field of decorative and impressionistic lighting opened up by the new lamp.

WARD HARRISON, director of General Electric's Nela Park engineering department, and the new fluorescent lumiline lamps

Basically the lamps are mercury-vapor lamps with argon gas present as a starter. The ultra-violet of the mercury spectrum is converted by the fluorescence of the particular chemical powder placed in the tube into visible light of a characteristic tint. Special transformers or chokes are required as in the case of all electric-discharge lamps.

Data given by Hibben show that the efficiency ranges from 3 lumens per watt for red up to 60 for green with a value of 32 for either daylight or "warm" white. Harrison announced that manufacture is now being confined to the 15, 20 and 30-watt sizes with respective tube lengths of 18, 24 and 36 inches.

The meeting was held under the joint auspices of the New York Electrical Society and the New York sections of the A.I.E.E. and the Illuminating Engineering Society.

A capacity audience attended.

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Thirteen Awards Won for Design of Lamps

In the first nation-wide lamp design competition, sponsored jointly by the American Institute of Architects, the American Institute of Decorators and the Illuminating Engineering Society, thirteen awards were made last week in the $1,700 contest.

Marked originality of design and technical lighting principles featured the majority of the 200 entries, according to Harry V. Anderson, editor of *Interior Design and Decoration*, competition adviser. Entries were submitted by architects, interior designers and design students from eighteen states and Montreal, Canada, in four different period design classes. Each class carried a first prize of $200 and two honorable mentions of $100 each.

The contest was sponsored for the purpose of stimulating improvement in the design of portable lamps by requiring that the essential specifications of I.E.S. as well as the standards of professional designers of interiors be met in products that will reflect the latest scientific as well as esthetic advancement.

Views Serious Potential Danger In Government Subsidized Service

Fowle says once foothold is secured it will spread to displace private investment and private employment — Midwest Power Conference told that federal projects offer little saving in family electric bill

A serious potential danger exists that when government subsidized service once secures a foothold it will gradually spread, and not only tend to displace the private electric utilities, but extend ultimately to socialization of railroads and communications, in the opinion of Frank F. Fowle, consulting engineer of Chicago.

Speaking before the Midwest Power Conference, sponsored by the Armour Institute of Technology and held in Chicago last week, Mr. Fowle stated that if the government were to take over the railroads, power systems and telephone systems today, the total private investment to be absorbed would be on the order of $45,000,000,000.

Chicago Daily News

C. F. HIRSHFELD, Detroit Edison Company, addressing the power conference

Power over industry

"The general shock to private capital and private employment which would come about with the socialization of the major service industries is very self-evident," Mr. Fowle said. "It would also place in the hands of the government a power over the entire business and population of the country which can only be contemplated with serious fear for the consequences." Mr. Fowle said that the fundamental need of two basic remedies for the overwhelming public debt, oppressive taxes and general prostration of business and industry is reduction of public spending and scaling down of the public debt.

Analyzing the government power projects, Mr. Fowle stated that assuming that subsidized competition would replace private enterprise in the entire regions within transmission distances of the hydro projects now completed or in progress, about 15 per cent of the present service as a whole would be affected. While it is conceivable that cost of electric service to the residential customer might be cut in half, he said, the average saving per family would only amount to about 1.2 per cent of the annual income.

Toward higher pressure

C. F. Hirshfeld, Detroit Edison, stated that in the power plant end of the utility business work is still progressing toward higher pressure and higher temperatures. He said that the industry is nearing the place where the graph representing the course of thermal efficiency with increasing temperature and pressure is approaching asymptotic characteristics. "We are almost at the place where we can predict with reasonable certainty how far we can increase thermal performance by present methods," he said.

The 1,200 to 1,400 lb. pressure range is now relatively common, Mr. Hirshfeld said, advances are being made to the region above 2,000 lb. He pointed out that the 900 to 1,000 deg. steam temperature limit is set by the metals available for use in superheaters, steam lines and turbine parts. "There is a real demand for a comparatively cheap alloy which will operate under high unit stresses at metal temperatures above 1,100 deg.," he declared.

Philip W. Swain, editor of *Power*, discussed the social significance of power progress. Conferences and discussions were held during the three-day meeting last week on leading topics concerning power, research, utilities and power plant equipment.

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Three Prizes Awarded for Lighting Designs

Prizes were presented last week to three architectural students at the University of Cincinnati for their entries in the 1938 competition for lighting design of the National Beaux-Arts Institute, sponsored by the local Ohio Valley Section of the Illuminating Engineering Society. Winners included K. Henry Merkel, Robert Deshon and Karl Schlachter.

The prizes were presented by John Morrison, chairman of the local section. Fred S. Dewey, chairman of the program and papers committee and general sales manager of Cincinnati Gas & Electric, was toastmaster. Walter W. Kantack of New York City was the principal speaker. Professor Pickering, head of the University of Cincinnati architectural department, announced the winners, who had been selected by George Marshall Martin, Colvin E. Pyle, Dwight Stevens, Allan K. Laig, J. H. Thornell and Paul H. Goodell, who acted as judges.

Approximately 200 students, alumni and members of the various societies participating in the program attended the meeting, which was conducted jointly by the Ohio Valley section of

WIN LIGHTING DESIGN—John W. Morrison, chairman of the local Ohio Valley section of I.E.S., presenting prizes to University of Cincinnati students Henry Merkel, first; Robert Deshon, second, and Karl Schlachter, third, in the 1938 National Beaux-Arts Institute lighting design competition

the I.E.S., the Cincinnati Architectural Society, the local sections of the American Institute of Architects and the Registered Architects of Ohio, and the University of Cincinnati Architectural Alumni. E. W. Hodgetts was in charge of arrangements.

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18 Utilities Ask High Court Ruling on TVA

Attempts to halt the Tennessee Valley Authority development were renewed last week as eighteen private utilities asked the U. S. Supreme Court to invalidate the Tennessee Valley Authority Act.

The companies appealed from the decision of a three-judge Federal Court of Appeals in Chattanooga, which ruled in January that they were not immune from the competition of TVA power "even if their business be curtailed or destroyed."

Doubts were expressed whether the justices could decide the issues before adjourning for the summer.

The companies involved are:

Tennessee Electric Power, Franklin Power & Light, Memphis Power & Light, Southern Tennessee Power, Birmingham Electric, Mississippi Power, Appalachian Electric Power, Carolina Power & Light, Tennessee Public Service, Holston River Electric, Alabama Power, Kentucky & West Virginia Power, Kingsport Utilities, Kentucky-Tennessee Light & Power, West Tennessee Power & Light, Mississippi Power & Light, East Tennessee Light & Power and Tennessee Eastern Electric.

Niles Sees Further Gains for Industry

A greater sense and application of integrity in business, as it applies to utilities as well as other industries, will do much to dispel strife and class prejudices which have characterized the political life of America as it exists today, in the opinion of Phillip Niles of American Water Works & Electric Company.

Speaking before a recent meeting of the Kiwanis Club of Connellsville, Pa., Mr. Niles pointed out that there is an opportunity for business to make a further contribution to the American people by applying integrity in business and demonstrating the initiative and character to furnish a sound and reliable service with constant improvement and extension.

Expressing the opinion that one of the great troubles of business in this country is that "we tried to operate on a slide-rule basis," Mr. Niles stated that "we have, with the highest motives in the majority of cases, tried to apply formulas and fixed principles which work well enough in production, but when applied to administration and sales have brought about many breakdowns. In other words, men tried to use in their relations with people the same basic principles as had been so successful in developing the machine."

Mr. Niles said that industry owes an obligation to its customers, its employees and its investors and that these three groups must be considered in decisions of managements.

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Buffalo Range Show Draws Large Crowd

More than 100 electric ranges were sold during the recent annual electric range show in Buffalo of the Electric League of the Niagara Frontier. Several hundred good live prospects were also obtained during the week of the show. Attendance was 38,732.

Samuel S. Vineberg, manager-secretary, stated that a complete schedule of publicity was used, including a very generous newspaper coverage, spot announcements over Buffalo's four radio stations and light bill inclosures in the form of prize drawing tickets sent out with 180,000 light bills during the four weeks preceding the show. "These light bill tickets advertised 'a range a day given away,' and it is believed they were in no small way responsible for the splendid success of the activity," he said.

Thirteen different makes of electric ranges were displayed by as many distributors and manufacturers. These included Frigidaire, Universal, L & H, Monarch, Estate, Kelvinator, Crawford, Westinghouse, General Electric, Standard, Norge, Quality and Hotpoint.

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Tennessee Electric Power Asks Review of PWA Loans

Tennessee Electric Power Company has asked the United States Supreme Court to review a lower court decision refusing to enjoin a $4,330,000 PWA loan and grant to the city of Chattanooga, Tenn., for the construction of a municipal electric system.

The three-judge district court recently dismissed the suit on the ground that the validity of the allotment was established by the Supreme Court decision in the Alabama Power and Duke Power decisions on PWA cases.

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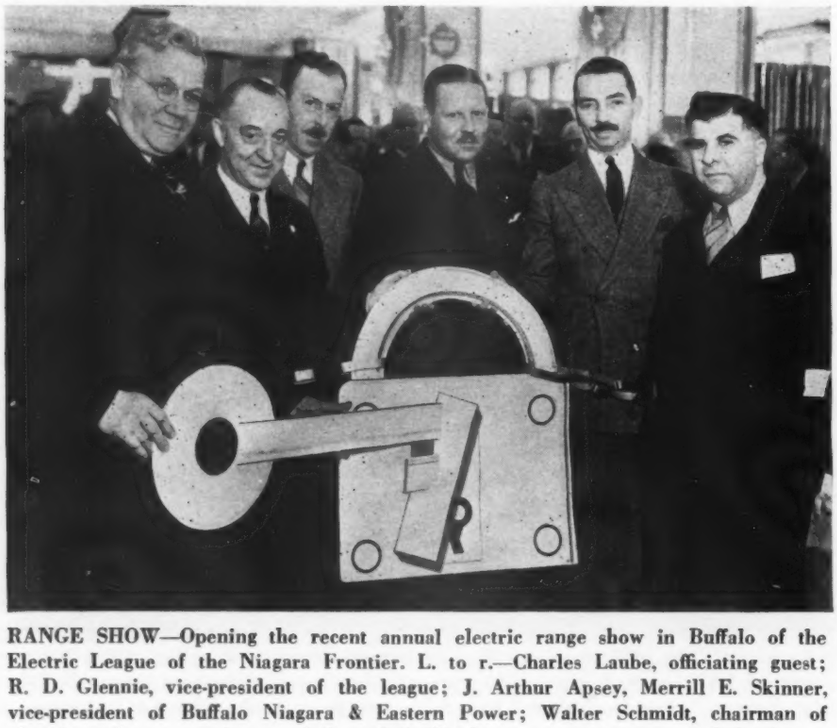
Ask NLRB Order Review

The International Brotherhood of Electrical Workers, affiliated with the AFL, last week joined with the Consolidated Edison Company of New York in asking the U. S. Supreme Court to review an order of the National Labor Relations Board directing the company to cease giving effect to a contract between the company and the brotherhood. The company filed a petition for review on April 2; the petition of the brotherhood was a separate action filed on April 12.



RANGE SHOW—Opening the recent annual electric range show in Buffalo of the Electric League of the Niagara Frontier. L. to r.—Charles Laube, officiating guest; R. D. Glennie, vice-president of the league; J. Arthur Apsey, Merrill E. Skinner, vice-president of Buffalo Niagara & Eastern Power; Walter Schmidt, chairman of electric cookery committee, and Samuel S. Vineberg, manager-secretary of the league

Spring Decline Continues

Week's energy production drops 9.9% under 1937—Reflects smaller industrial demand

Production of energy by the electric light and power industry moved downward during the week ended April 16 to 1,957,573,000 kw.-hr., according to the Edison Electric Institute, after a moderate upward turn during the two preceding weeks. Continuation of the downward trend is not abnormal at this time of the year, but the steepness of the decline reflects further slackening of industrial activity.

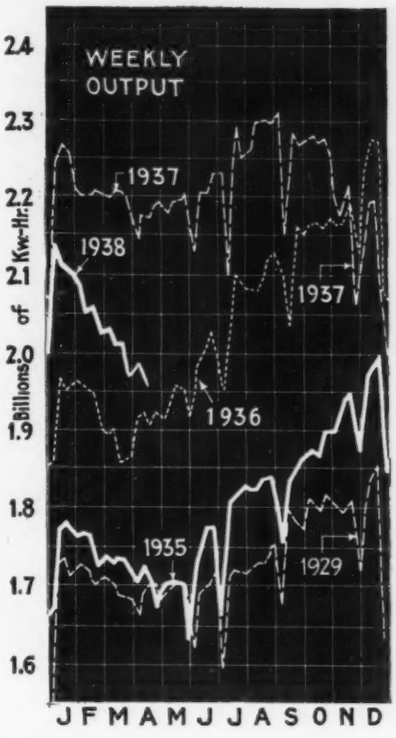
Compared with the corresponding week of 1937 the output declined 9.9 per cent, against the maximum, thus far, of 10.2 per cent in the week of March 26. It exceeded the like figure for 1936 by 1.2 per cent.

In the Central industrial area the decrease from 1937 rose to 17.7 per cent. In New England it also advanced, to 13.7 per cent. Both recessions are slightly beyond the respective highest percentages a few weeks ago. In the other predominantly industrial region, the Middle Atlantic, operations remain much nearer the 1937 level.

The Rocky Mountain region showed decrease less than the previous week.

Weekly Output, Millions of Kw-Hr.

1938	1937	1936
Apr. 16..1,958	Apr. 17..2,173	Apr. 11..1,934
Apr. 9..1,990	Apr. 10..2,176	Apr. 4..1,916
Apr. 2..1,979	Apr. 3..2,147	Mar. 28..1,867
Mar. 26..1,975	Mar. 27..2,200	Mar. 21..1,862
Mar. 19..2,018	Mar. 20..2,211	Mar. 14..1,901
Mar. 12..2,015	Mar. 13..2,213	Mar. 7..1,893



Per Cent Change from Previous Year

Region	Week Ending Apr. 16	Apr. 9	Apr. 2
New England	−13.7	−12.8	−12.2
Middle Atlantic	− 3.5	− 2.4	+ 0.5
Central Industrial	−17.7	−15.2	−15.2
West Central	− 3.7	− 1.6	− 1.7
Southern States	− 6.1	− 5.9	− 4.7
Rocky Mountain	−22.5	−23.1	−23.0
Pacific	− 1.4	− 1.3	− 2.2
United States	− 9.9	− 8.5	− 7.8

Cities Service Units Change Seen Likely

While the immediate outlook of Cities Service Company at this time is very unsatisfactory, the improved financial position of the company and subsidiaries puts them in a better position than they were in 1932 to withstand the ravages of a new depression, Henry L. Doherty, president, stated last week in the 1937 annual report to stockholders.

Commenting on registration with the SEC in compliance with the utility act, the report stated that "liquidation may ultimately be required of Cities Service Power & Light, principal subsidiary, or some disposition may have to be made of its subsidiaries." It was also indicated that Cities Service will make provisions for the readjustment or relinquishment of its present power of control over this company and its subsidiaries. The electric utilities may be divorced from gas and oil properties.

Gross operating revenues of the electric light and power subsidiaries in the system in 1937 were $49,663,000, or about 20 per cent of the system's total gross. Kilowatt-hour sales were the largest in history, exceeding 1936 by 10.5 per cent. Numerous rate reductions and greater taxes were seen as preventing gains in earning power equivalent to those in output and energy sales.

Calling attention to the increase in taxes, the report stated that "the company and its subsidiaries bear a tax burden annually equal to all earnings accruing to the security holders whose investments created the business." Total taxes on the property and operations of the system in 1937 were $44,567,000, of which $23,512,000 were indirect taxes collected from customers.

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Rate Hearing Postponed

FPC has postponed until May 3 the hearing scheduled to be held April 18 on the commission's suspension of a rate schedule of the Oklahoma Gas & Electric Company which was filed by the company under a proposed new agreement with the Public Service Company of Oklahoma and the Southwestern Light & Power Company and covers the sale and interchange of firm, excess, dump and emergency electric energy among the three companies. Postponement was made at the request of the Oklahoma Gas & Electric Company.

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Bond & Share Sees Service Profits Cut

A reduction in service profits for 1938 of the Electric Bond & Share Company is indicated by the company's first major action in compliance with the Public Utility Holding Company Act, reported last week in a letter to stockholders.

As of April 1, the service subsidiaries have been rendering general and engineering services at cost to domestic client operating companies. For the first quarter of 1938 the profit on general services to such companies approximated $110,000 and on construction and engineering services approximated $99,000, according to the letter, signed by C. E. Groesbeck, chairman, and S. R. Inch, president.

Chief among the problems confronting the company, the officials stated, "is the problem of seeking a way, without loss to the security holders, of conforming this group of companies to the realignment of the industry contemplated by Section 11 (of the utility act)." The letter pointed out that this section affected the company most seriously because of the diversity of location of enterprises represented by its investments.

For the first quarter net income was $2,145,508, as against $2,460,049 for the first quarter last year. Part of the decrease is accounted for by the fact that a dividend of $296,000 which normally would have been paid this quarter was received in December, 1937.

The resignations, as directors, of Francis H. Brownell, Edwin G. Merrill, William C. Potter, C. J. C. Quinn and Samuel H. Wolcott were also reported.

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To Sell Power System

Electors of Olpe, Kan., on April 2 cast 165 votes favoring the sale of the distribution system to the Kansas Electric Power Company. There were no opposition votes. Olpe has heretofore been served by the company on a wholesale basis. The city has a population of 309.

Utility Stocks Hold Their Ground

While electric power and light stocks closed lower on Tuesday last, the "Electrical World" index showed a slight gain for the week, rising this week to 23.9. Index previous week, 23.8; corresponding week a year ago, 34.6

$60,000,000 Issue Offered by Edison

Consolidated Edison Company of New York issued this week $60,000,000 of ten-year 3½ per cent debentures at 101¾ to yield 3.29 per cent. The debentures were dated April 1, 1938, and are to be used on June 1 for the redemption of Consolidated Gas Company twenty-year 4½ per cent gold debenture bonds in the same amount due on June 1, 1951. The 4½s will be redeemed at a premium of 5 per cent.

New York & Queens Electric Light & Power Company has placed privately with a large group of insurance companies a $10,000,000 issue of first and consolidating mortgage bonds, 3¼ per cent series, dated May 1, 1938, and due on May 1, 1968. The bonds were priced at 101. Proceeds will be used to discharge an obligation of $7,000,000 to the Consolidated Edison Company and for expansion.

•

Associated Drops Two Units

Ware County Light & Power Company and Insular Light & Power Corporation, units of Associated Gas & Electric System, have been dissolved. This brings to 351 the number of companies eliminated from the system by dissolution, consolidation and merger.

•

SEC Sets Utility Hearing

A hearing has been called for April 27 by the SEC on an application by New York State Electric & Gas Corporation of Ithaca, N. Y., a subsidiary of the Associated Gas & Electric Company system, for exemption from the requirement for filing a declaration with respect to the issue and sale of $2,000,000 of 4 per cent serial notes to mature in twenty equal installments of $100,000 each to the Chase National Bank, New York.

•

New Directors Elected

Stockholders of the Utilities Power & Light Company have elected M. L. Sindeband and Austin T. Gardner of New York as directors. Mr. Sindeband was formerly vice-president of the American Gas & Electric Company and a receiver for the Columbus, Delaware & Marion Light & Power Company. Mr. Gardner has been in the utilities field about ten years.

•

Commission Bars Merger

In recently denying the petition of the Staten Island Edison Corporation for approval of its merger with the Richmond Light & Railroad Company, the New York Public Service Commission, suggested that the latter company be eliminated "through dissolution proceedings" instead. The electric properties of the Richmond Light & Railroad Company were transferred to Staten Island Edison in 1923.

•

Portland Merger Sanctioned

FPC has granted the application of the Portland General Electric Company, filed in December, 1937, for the merger with the company of five of its wholly owned subsidiaries, Yamhill Electric Company, Mollala Electric Company, Electric Supplies & Contracting Company, Electric Appliance & Construction Company and Clackamas Power & Irrigation Company. All are corporations organized and existing under the laws of Oregon.

•

Bond & Share Units Register With SEC

American Gas & Electric Company, New York, has registered as a holding company with the SEC and has filed an application for an order declaring it not to be a subsidiary holding company in the Electric Bond & Share System. Eastern Utilities Associates of Boston; National Power & Light Company, the Lehigh Power Securities and the American Power & Light Company, all of New York, have also filed notifications of registration under the Public Utility Holding Company Act. The three last named companies are all subsidiaries of the Electric Bond & Share Company. Two other subsidiaries of the holding company system of the Electric Bond & Share Company recently registered—Utah Power & Light Company and the Pacific Power & Light Company.

Among the statements covering new security offerings filed recently are the following:

Puget Sound Power & Light Company, $7,000,000 of first and refunding mortgage 6 per cent gold bonds, Series E, due in 1950. Proceeds will be used to discharge or refund $2,919,500 of 5½ per cent gold coupon notes due in 1940; $3,990,000 of Pacific Coast Power Company 5 per cent gold bonds due in 1940 and to reimburse the company's treasury in the amount of $78,980 to acquire $80,500 of the 5½ per cent gold notes, and for other purposes.

San Antonio Public Service Company, $17,000,000 of first mortgage 4 per cent bonds due in 1963 and $2,500,000 of 4 per cent serial notes due April 15, 1939 to 1948.

Iowa Power & Light Company, $5,700,000 of 4 per cent first mortgage bonds, due 1968, to be sold privately.

Earnings Reports (Utilities)

	Net Income 1938	1937
‡The Detroit Edison and subs.	$8,360,417	$10,504,409
†Northern States Pwr. (Del.) and subs.	6,140,855	5,183,977
†San Diego Cons. G. & E.	1,329,111	1,389,588
†Wisconsin Pub. Serv. Corp. and sub.	1,358,927	1,257,169
†Philadelphia Co. and subs.	7,551,367	8,053,189
*Oklahoma G. & E.	2,567,214	2,495,673
*Virginia Elec. & Pwr.	3,348,879	3,224,106
*Puget Sound Pwr. & Lt. and subs.	1,194,786	1,162,443
*Gulf States Utilities.	1,283,216	888,287
*Utah Pwr. & Lt. and subs.	1,700,589	1,466,173
*Pacific Pwr. & Lt. and sub.	791,332	746,611
*Central Arizona Lt. & Pwr.	856,938	579,572

‡ Twelve months ended March 31.
† Twelve months ended January 31.
* Twelve months ended February 28.

California Edison's Earnings Set Record

Gross revenue from operations of the Southern California Edison Company, Ltd., during 1937 were the largest in the company's history, amounting to $42,289,604, as against $41,656,018 during 1936, according to Harry J. Bauer, president.

Of this amount, light revenue amounted to $18,814,599, an increase of 10 per cent, while power revenue amounted to $22,462,213, a decrease of 7 per cent, due principally to the loss of the wholesale business of the cities of Los Angeles, Glendale and Burbank. Taxes for the year 1937 were also a record, being $6,926,137, as against $6,233,120.

Transmitted output of the company during 1937 totaled 3,138,653,552 kw.-hr., compared with 3,492,531,808 during 1936, a decrease of 4 per cent; 94 per cent of the total kilowatt-hours transmitted were generated at water power plants.

The co-operative load-building campaign of the company, which has shown substantial increases in load each year since its inauguration in the fall of 1933, added 167,930 hp. of load during 1937, in these classifications: Residential lighting, 24,107 hp.; commercial and industrial lighting, 26,619 hp.; street and highway lighting, 602 hp.; agricultural pumping, 27,082 hp.; miscellaneous agricultural sales, 5,508 hp.; commercial and industrial air conditioning and heavy duty cooking, 7,877 hp.; industrial power, 55,601 hp.; oil industrial power, 12,110 hp.; industrial heating, 8,424 hp. Average annual kilowatt-hour consumption by residential customers on December 31, 1937, was 910 kw.-hr., compared with 807 kw.-hr. on December 31, 1936.

Company's budget for new construction for 1938 provides for expenditures of $6,774,244, as follows: Transmission and distribution systems, $3,273,326; completion of Boulder Dam transmission line, $1,566,043; additional facilities for receiving Boulder Dam power at Chino and Barre substations, $1,399,296; general expenditures, $535,579. (Budget was approved prior to recent flood, which caused an estimated $400,000 damage to the system properties.)

Net income for 1937 was $12,136,162, compared with $12,760,560 for 1936.

•

Lets Transformer Contracts

Imperial Irrigation District, El Centro, Calif., has made awards for forty-six 33,000-volt transformers, 100 to 4,000 kva., at a total cost of $106,696, the contracts being divided between the Pennsylvania Transformer Company, Pittsburgh, Pa., which secured the order for the larger-sized units at $74,500, and the Allis-Chalmers Manufacturing Company, Milwaukee, which will furnish the smaller-sized transformers at $32,196. The transformers will be installed in thirteen power substations on the All-American Canal hydro-electric power system.

•

Work on Mill Rushed by Bridgeport Brass

Bridgeport Brass Company has completed a good portion of the work on its new rolling mill and the building for housing the mill offices and metallurgical laboratory. The work is proceeding under the supervision of Stone & Webster Engineering Corporation.

The company stated that the overhead electric cranes have been erected and most of the large intricate concrete foundations for the electrically operated and controlled machinery have been built. Several annealing furnaces are partially constructed and already the large electric generators and some of the machinery have been installed. It is expected that this unit will be in operation by August.

It was stated by the company that the mill will be one of the largest and most efficient of its kind in the world. Practically all of the copper base alloys will be produced in sheet form. It follows the straight line principle of production which has proved to be so effective in the steel and other major industries. The plant represents an investment of approximately $4,000,000.

•

Long Island Lighting Plans Office Building

Long Island Lighting Company plans the construction of a five-story office building at Mineola, L. I., according to Edward F. Barrett, president. It was stated by Mr. Barrett that when the new building is completed, around the first of next year, the executive offices and virtually all departments of the company, now at 50 Church Street, New York City, will move into the new offices. The cost of the new building is estimated at $300,000 and a cash saving of about $35,000 is expected to result from the move.

Mr. Barrett disclosed that the $2,300,000 of first mortgage bonds due in 1960 and recently authorized by the Public Service Commission will be sold to the Equitable Life Assurance Society and the proceeds used to pay bank loans of the company.

Connecticut Utility Installs New Cable

The first three-conductor, No. 4/0, 66-kv., type H oil-filled cable to be ordered in this country has been installed on the property of the Stamford Gas & Electric Company to serve the double purpose of connecting this company's isolated Stamford plant with the Connecticut Light & Power Company and to provide a second independent power supply for the city of Norwalk, Conn. Norwalk has hitherto been supplied over a double-circuit transmission line from the Devon plant of Connecticut Light & Power. This cable interconnection, which was put into operation on March 17, is giving satisfactory service.

In addition to making operating economies possible through interconnection, this cable link also allows a considerable saving in investment for additional generating capacity to be realized by both companies.

The present installation of two three-phase oil-filled cables, each 0.4 mile in length, was made in a duct line that until April 6 also housed 27-kv. cable serving the town of Greenwich, Conn. Energy for Greenwich was formerly purchased at the busbars of the Stamford plant by the Connecticut Light & Power Company and transmitted over the 27-kv. cable. With the installation of the 66-kv. cable the 27-kv. installation has been dismantled. Greenwich is now served through the oil-filled cable via the Norwalk-Cos Cob transmission line, with which it connects.

Energy is generated at the Stamford plant at 4,160 volts and stepped up to 66 kv. before entering the oil-filled cable. Since it is planned to rewind one of the Stamford generators for 13.8 kv., a winding designed for that voltage is provided in the 18,750-kva. transformers in addition to the 4-kv. and 66-kv. windings necessary for current operation. These transformers, one for each cable circuit, are oil filled and water cooled.

•

Graybar Opens New House

Graybar Electric Company recently opened its new office in Columbia, S. C., the 85th in Graybar's national system of distributing houses. This office serves practically the entire state of South Carolina.

•

Wagner Electric Contract

Metropolitan Water District, Los Angeles, Calif., has awarded a contract to the Wagner Electric Corporation, St. Louis, for station light and power transformers at $11,910.

Sees Gain Over 1937 in Load Contracts

Contracts with the Consolidated Gas, Electric Light & Power Company of Baltimore for additional connected electric power load were greater in the first two months this year than in the corresponding period of 1937, according to Herbert A. Wagner, president.

While industrial and heavy commercial electric consumption was decreased by the current recession, domestic usage continued to show an increase over the same months of last year, although at a lessened rate, Mr. Wagner added.

Revenue from electric sales for the first two months this year totaled $4,250,151, against $4,182,626 for the corresponding period of 1937. However, this increase was more than offset by higher operating expenses, chiefly because of higher charges to operations for labor, materials, depreciation and taxes. Consolidated net income was $1,166,907, equal after preferred dividends to 94 cents a share, against $1,239,722.

Earnings for the first two months this year also reflect the benefit to the company of the electrification of the Pennsylvania Railroad's main line west to Harrisburg, Pa. All passenger trains over the newly electrified line are now drawn by electric locomotives and it is expected that operation of freight trains with electric locomotives will begin in the area at an early date.

•

Atlanta Section Extended

The board of directors of the American Institute of Electrical Engineers has authorized a change in name of the Atlanta section to "Georgia Section" and the extension of its territory to include the entire state of Georgia. The membership of that section will thereby be increased from some 80 to more than 100 members. H. N. Pye, chief engineer, South Eastern Underwriters Association, is present chairman of the section.

•

Miami Mayor Is Ordered to Trial on Bribe Charge

Last week the Florida Supreme Court ordered Mayor Robert R. Williams of Miami to stand trial on a charge of attempting to exact a $250,000 bribe from Florida Power & Light. On another charge, that he conspired with other officials to accept the alleged bribe, the Mayor was ordered freed.

Last December 16 Bryan C. Hanks, president of the Florida utility, charged that city officials had sought a bribe to clear up the rate controversy. When the charge was made by Mr. Hanks a city investigation was started, resulting in indictments against City Commissioners John W. Dubose and Ralph B. Ferguson and City Rate Expert Thomas E. Grady.

•

Bureau Adopts New Name

Birmingham Electric Refrigeration Bureau has changed its name to Electric Appliance Bureau and made its code of ethics applicable to electric ranges, washers and ironers as well as electric refrigerators. R. P. McDavid, Birmingham Kelvinator distributor, was elected president for 1938, succeeding E. H. Henley, and L. W. Curl, manager of Birmingham's Frigidaire branch, was named vice-president.

Meetings

Electrochemical Society — Spring meeting, Savannah, Ga., April 27–30. Dr. Colin G. Fink, secretary, Columbia University, New York, N. Y.

Association of Iron and Steel Engineers—Annual spring conference, Baltimore, Md., April 28–29. Brent Wiley, managing director, Empire Building, Pittsburgh, Pa.

Maryland Utilities Association — Annual meeting, Lord Baltimore Hotel, Baltimore, Md., April 29. E. J. Roche, secretary, 55 E. Washington St., Hagerstown, Md.

Edison Electric Institute—Engineering committees meetings, Edgewater Beach Hotel, Chicago, Ill., May 2–5. Bernard F. Weadock, managing director, 420 Lexington Avenue, New York, N. Y.

Refrigerating Machinery Association — Spring meeting, Hot Springs, Va., May 11–12. Association headquarters, Southern Building, Washington, D. C.

National Fire Protection Association — Annual meeting, Atlantic City, N. J., May 9–13. A. R. Small, 207 East Ohio St., Chicago.

Air Conditioning Manufacturers' Association—Annual meeting, Hot Springs, Va., May 13–14. Association headquarters, 915 Southern Building, Washington, D. C.

National Electrical Manufacturers Association—Spring conference, The Homestead, Hot Springs, Va., May 15–20. W. J. Donald, managing director, 155 East 44th St., New York, N. Y.

American Institute of Electrical Engineers—Northeastern district meeting, Lenox, Mass., May 18–20. H. H. Henline, national secretary, 33 West 39th St., New York, N. Y.

National Electrical Wholesalers Association—Annual convention, The Homestead, Hot Springs, Va., May 22–26. Alfred Byers, secretary, 165 Broadway, New York, N. Y.

National Association of Purchasing Agents—Annual international convention, St. Louis, Mo., May May 23–26. Association headquarters, 11 Park Place, New York, N. Y.

Makes Rural Loans; Wiring Allotments

The following allotments have recently been announced by the Rural Electrification Adminstration:

MICHIGAN—Tri-County Electric Co-operative, Inc., $75,000 for construction of a generating plant. The project has been allotted $600,000 to build 550 miles of line to serve 2,575 customers in Ingham, Livingston, Clinton, Washtenaw, Ionia, Eaton, Calhoun, Branch, Kalamazoo, St. Joseph, Jackson and Barry counties, and $8,000 to finance house wiring and plumbing installations. Fruit Belt Electric Co-operative, $50,000 to build 50 miles of line, 250 customers in Berrien, Cass and St. Joseph counties.

SOUTH CAROLINA—County of Greenwood, $15,000, to build approximately 12 miles of line, 97 customers in Greenwood and Newberry Counties.

CALIFORNIA—Surprise Valley Electrification Corporation, $27,500, 20 miles of line. Project had previously been allotted $410,000 to build 349 miles of line, to serve 809 customers in Modoc and Lassen counties, Calif., and Lake County, Ore., and $90,000 to construct a generating plant.

FLORIDA—West Florida Electric Co-operative Association, Inc., $100,000 to build 100 miles of line, 500 customers, 226 of which have already signed up in Jackson, Calhoun and Holmes counties.

OREGON—Umatilla Electric Co-operative Association, $35,000 to build approximately 33 miles of line. Project previously has been allotted $129,000 to build 126 miles of line to serve 410 customers in Umatilla and Morrow counties, and $10,000 to finance house wiring and plumbing installations.

Among the recent allotments to finance house wiring and plumbing installations, to be re-lent by the borrowers to their individual members, are the following:

DELAWARE—Delaware Rural Electric Association, Georgetown, Del., $22,037 for about 150 customers.

MINNESOTA—Wright-Hennepin Co-operative Electric Association, Cokato, Minn., $10,000 for about 100 customers.

PENNSYLVANIA — Northwestern Rural Electric Co-operative Association, Saegertown, Pa., $10,000 for about 100 customers.

WISCONSIN—Oconto Electric Co-operative, Oconto Falls, Wis., $10,000 for about 100 customers.

•

Holds Course on Meters

Agricultural and Mechanical College of Texas, has just completed a short public utility course for electric metermen with registration of 73, according to Norman F. Rode, professor of the department of electrical engineering. The course, lasting a week, included discussions and talks on electricity, circuits and meters. There were sixteen representatives of manufacturers and 57 from utility companies in Texas, Louisiana, New Mexico and Oklahoma.

Field OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

Mobile Power Unit Serves Isolated Load

By GEORGE KAUFFMAN

Philadelphia Electric Company, Philadelphia, Pa.

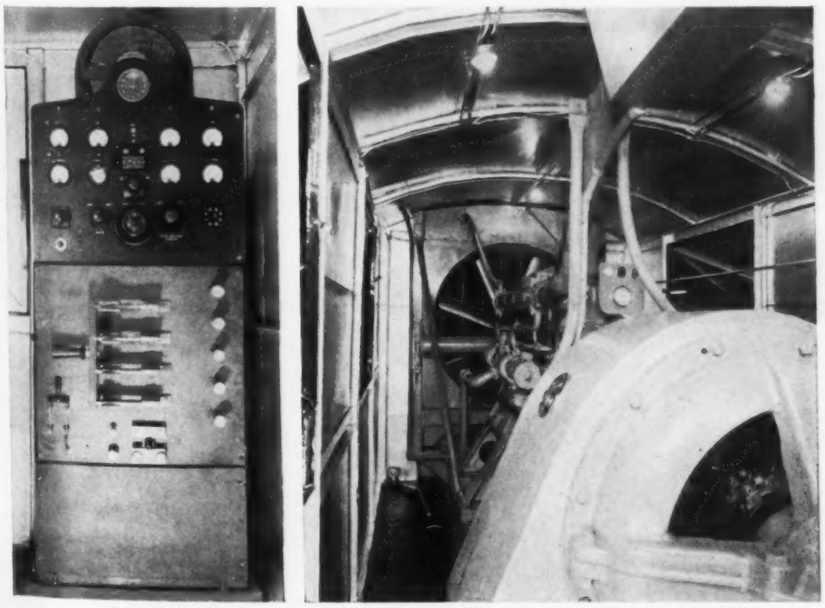
In order to supply single-service customers during periods of routine maintenance or while underground service is down for extension the Philadelphia Electric Company has assembled a mobile, truck-mounted engine-generator set which has a capacity of 187.5 kva., 230 volts, 60 cycles, two or three phase.

The set is mounted on a 5-ton Mack truck and has a gross weight of 26,000 lb., of which 11,300 lb. is the engine-generator set. A special air-cooled, Scott-connected generator makes it possible to deliver 115 or 230 volts, two phase, five wire or 230 volts three phase as desired. In good weather outside air for generator cooling may be taken in through a hole in the truck floor. During heavy snow or rain storms a shutter closes this opening and another shutter allows air for cooling to be taken from a point close to the engine room floor.

A 250-300 hp., 1,800-r.p.m. Sterling gasoline engine drives the generator. This engine is equipped for cooling with city water or a radiator. With the radiator cooling system in use 25 hp. of the engine's capacity is required to drive the fan. A built-in governor insures operation with a speed regulation of 5 per cent between no load and full load and with a regulation of 2½ per cent between no load and 50 per cent full load. The engine is provided with triple ignition system, dual carburetion and has an overspeed trip operating at 1,900 r.p.m.

The fuel tank has a capacity of 108 gal. of gasoline, which at the engine's fuel consumption rate of 18 gal. per hour, is enough for six hours operation. An air pump, driven by a 1/6-hp. electric motor supplied from the generator, allows the fuel tank to be filled while the engine is operating. Exhaust from the engine is forced out over the cab of the truck and passes through a Maxim silencer.

A switchboard, mounted on 2-in. cork vibration insulation, provides all the necessary instruments and controls for proper operation of the generator either two or three phase. At present the set is not equipped for operating in synchronism with the system; this is being contemplated, however.



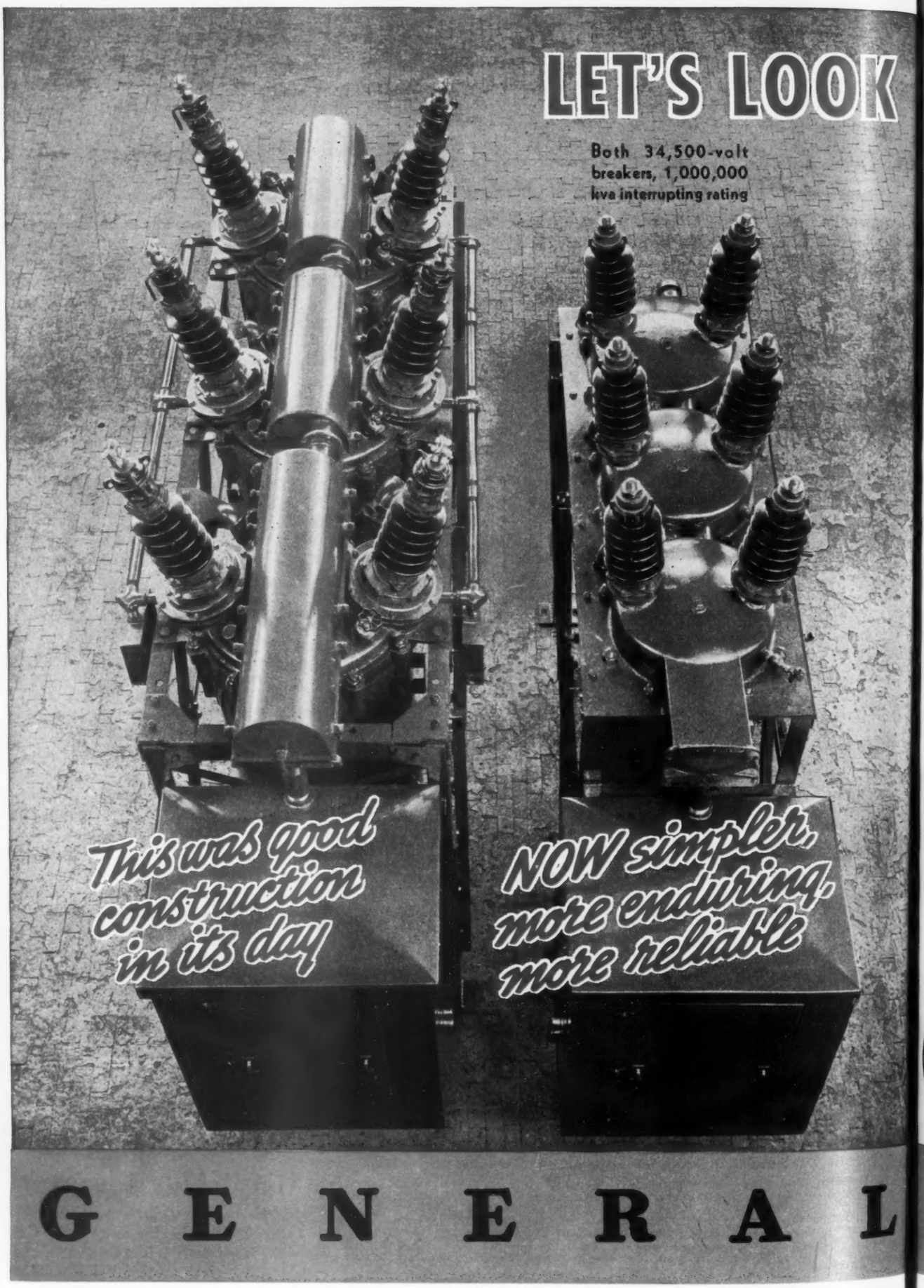
Truck-mounted engine generator set supplies single-service customers during enforced outages for inspection and maintenance

Left—Control instruments for portable set. Top row, four ammeters, one for each two-phase leg. Second row, a.c. voltmeter, fuel gauge, phase rotation indicator, voltmeter and ammeter for generator exciter. Third row, selector switches for a.c. voltmeter, lights, rotation indicator (2-3 phase), field rheostats, phase rotation indicator switch (line-generator), 9-point meter plug; below 600 amp. generator switch and terminals, exciter switch and 2 3-phase bridging connections. Right—Lights in the engine room can be operated from the 12-volt battery or from the generator through a 500-watt, 230/12-volt transformer.

•

Device Sears Number on Rubber Gloves

New rubber gloves purchased by the Public Service Electric & Gas Company after initial inspection and test are given an identifying number


LET'S LOOK
Both 34,500-volt breakers, 1,000,000 kva interrupting rating
This was good construction in its day
NOW simpler, more enduring, more reliable
GENERAL

AT BREAKERS ANOTHER WAY

and See the Importance

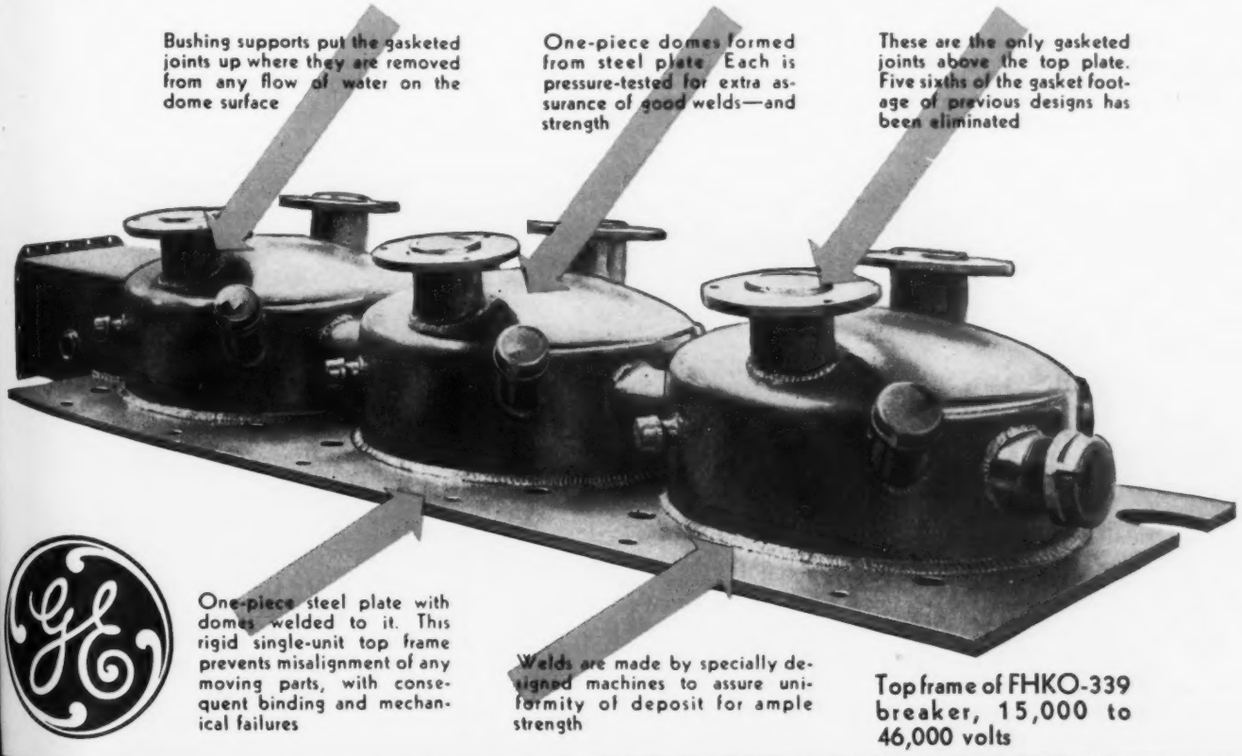
of Good **MECHANICAL** *Design*

A PERFECT electrical theory has value only in its physical embodiment. Given a good theory, capable apparatus must be built to obtain its benefits. You are interested in the theory; you must *use* the apparatus.

An oil circuit breaker fundamentally is an electric device. But the operation of an oil circuit breaker is a mechanical operation. Although its function is entirely electric—opening and closing a circuit—by far the greater part of the breaker is a steel structure and mechanism, every element of which makes a vital contribution to the job at hand. In clearing short circuits, breaker operation requires sudden and rapid acceleration of the moving parts, involving tremendous physical forces. Mechanical design, therefore, is a very important factor.

For years General Electric engineers have recognized the extreme importance of mechanical perfection of oil circuit breakers. This conviction is reflected in modern G-E breakers in which ample strength of frame, tank, and mechanism parts is beyond question; in which there is no compromise with quality of materials; and in which provisions are made for resisting wear and preserving alignment, so that the original performance of the breaker will endure.

The brilliant record of modern G-E oil-blast circuit breakers has been enhanced materially by their outstanding mechanical construction.


Bushing supports put the gasketed joints up where they are removed from any flow of water on the dome surface
One-piece domes formed from steel plate. Each is pressure-tested for extra assurance of good welds—and strength
These are the only gasketed joints above the top plate. Five sixths of the gasket footage of previous designs has been eliminated
One-piece steel plate with domes welded to it. This rigid single-unit top frame prevents misalignment of any moving parts, with consequent binding and mechanical failures
Welds are made by specially designed machines to assure uniformity of deposit for ample strength

Top frame of FHKO-339 breaker, 15,000 to 46,000 volts

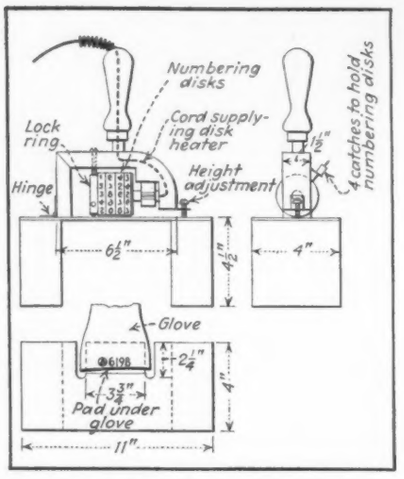
L E L E C T R I C

890-67

that they bear throughout their life. Against this number is entered the date of test and inspection, the names of men using the gloves and other information.

To make this number a part of the glove and insure against its becoming detached or illegible through use, the glove number is burned into the gauntlet with an "Everhot" electrically heated numbering machine which has been mounted on a stand for bench use, as shown in the accompanying sketch.

In order that the numbers will not be burned into the rubber glove far enough to result in a hole an adjustment is provided which allows the numbers to be seared on the surface just deep enough to be permanently legible without damaging the rubber.



Electrically heated numbering machine sears identification on linemen's rubber gloves

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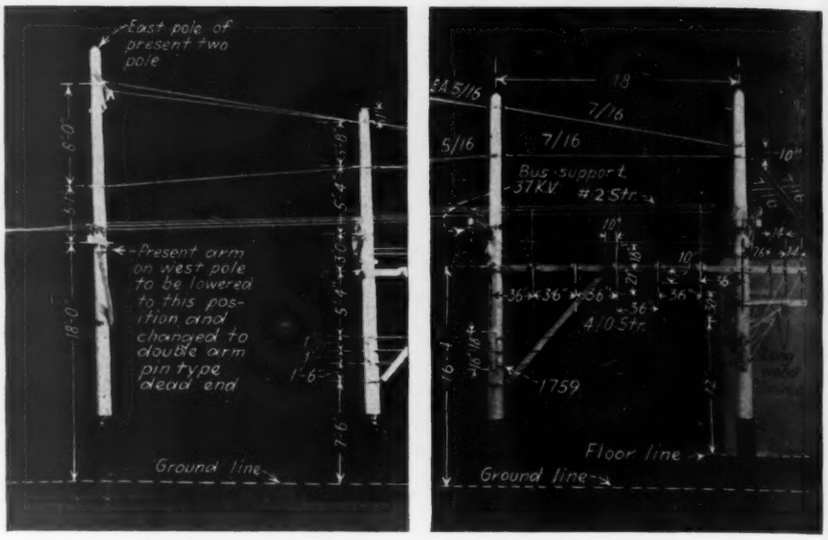
Build Structures From Model Photos

By O. A. PENDLETON
Empire District Electric Company, Joplin, Mo.

Substation installations and overhead line structures, such as crossings, corners, etc., are frequently first erected in model form, to a definite scale, in order that clearances, arrangements and appearances may be studied before final drawings are made. Some electric utilities, among which is the Empire District Electric Company, have complete supplies of replicas in miniature of poles, crossarms, transformers, oil circuit breakers, insulators, etc., so that almost any construction problem may be studied in all three dimensions.


East pole of present two pole
Present arm on west pole to be lowered to this position and changed to double arm pin type dead end
Ground line
Bus support 37KV #2 Str.
4/0 Str.
1759
Floor line
Ground line

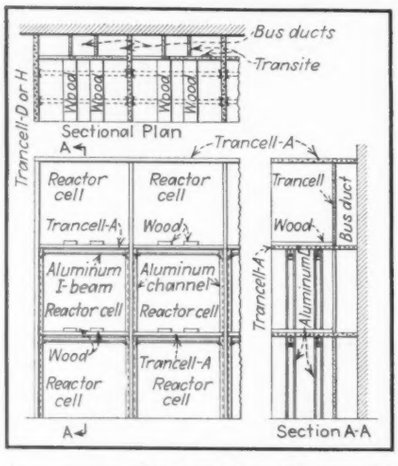
Pictures of model serve as construction drawings

It was impossible to put this substation on one photograph without compressing detail too much. Therefore two overlapping views were taken.

Usual practice is to make convential drawings and prints for field construction from the model structure. This, however, is not always done. Photographs of as many elevations and views as desired are made with an ordinary camera. Enlargements, usually about 8 x 10 in., are made from these prints and all dimensions and notes are inked on them with red sign painter's ink. The enlarged photographs are supplied to the construction foreman instead of the convential drawings and are liked much better than blueprints as they give a visual idea of the completed structure. If the model has been set up for study the cost of enlarged photographs with dimensions is much cheaper than a complete set of blueprints.

•

LAYOUT FOR REACTOR MOUNTING



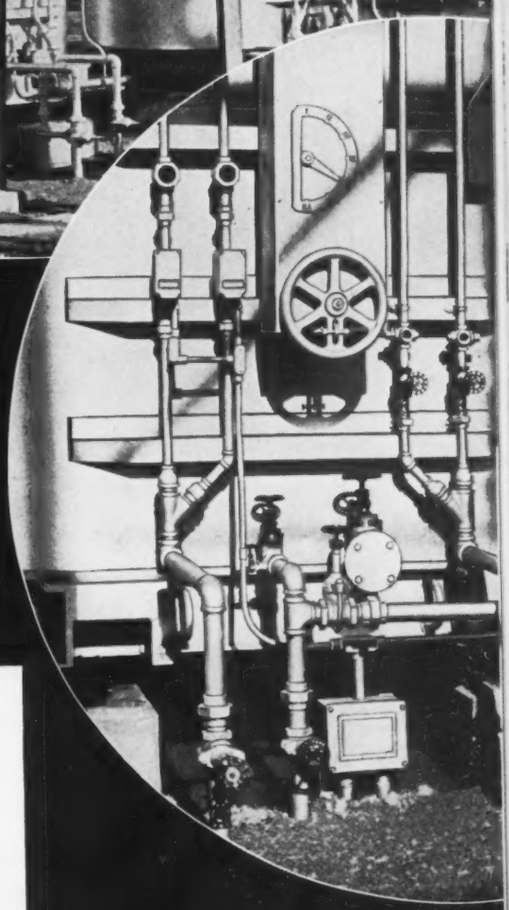
Arrangement of fire-resisting isolating cells for mounting and inclosing power plant reactors, proposed by Johns-Manville Inc.

Devise In and Out Meter Installation

Temporary installation of graphic watt-hour demand meter and reactive-kva. meter is a fairly common event on the system of the Milwaukee Electric Railway & Light Company. When a customer increases his consumption to a certain amount it is possible that he may benefit by a rate reclassification.

However, to eliminate all supposition, it is necessary to get complete data as to demand and power factor, as well as kilowatt-hours used on the installation. To obviate the work that would be required in hooking up and disconnecting temporary instruments, a number of mounted assemblies of the type shown in the accompanying sketch were made up in the meter department of the company. Occupying one side of the vertical panel is a graphic watt-hour demand meter and on the other is hung the reactive-kva. meter with a seven-terminal connection block and a four-pole, double-throw knife switch. The switch is to reverse the direction of rotation of the reactive meter without disturbing any connections. In order to save space it is mounted on top of the reactive auto-transformer. All equipment is

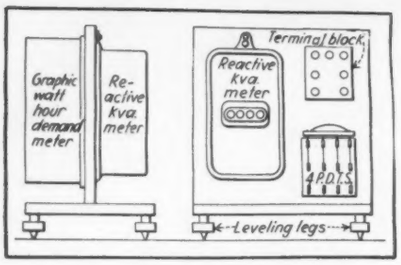
3—10,000 Kva MOLONEY 110,000 volt, Single Phase, Water Cooled Transformers



You will agree

. . . that transformers, especially Power Transformers, should represent long-term investments. Economy in purchasing, therefore, depends upon the life of the transformers, together with their operating costs. These two factors are determined by the quality of design and manufacture. Moloney never sacrifices quality for the benefit of price. You can be certain that when you buy Moloney Transformers, you will get fine Performance along with real Economy. Moloney Electric Company, Saint Louis.

MOLONEY TRANSFORMERS



Meter assembly for temporary installation

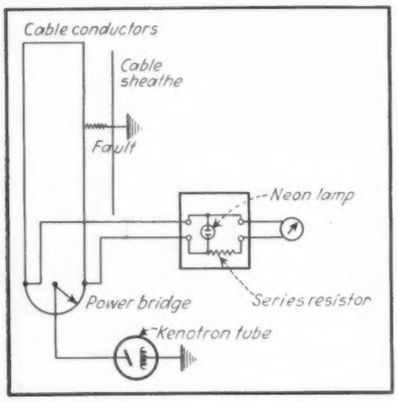
rated at 5 amp., 240 volts. This outfit is then connected in series with the customer's regular meter and allowed to remain a week or two.

•

Protect Galvanometer of Power Bridge

By ARTHUR W. WEEKS
Boston Edison Company

High-resistance cable faults are frequently difficult to maintain with the low-voltage supply for a power bridge used as a Murray loop. When using a kenotron for breakdown tests it is logical to use the kenotron out-



Connection scheme for high-tension bridging with protective device in circuit

put for a source of current for the power bridge. Since this current is at high potential, the fault is maintained while it is being located by the Murray loop method. If the bridge is badly unbalanced the galvanometer used as a detector may be damaged, so the following method of protection was devised. The base was removed from a small neon glow lamp and the series resistance eliminated. This reduces the voltage required to cause the lamp to flash and the flashover voltage without the resistance is determined. Sufficient resistance is connected in series with the galvanometer to bring the safe voltage for the galvanometer and resistance above the flashover voltage for the glow lamp. It is assumed that the galvanometer would not be damaged by $1\frac{1}{2}$ times the voltage necessary to produce full scale deflection. The neon lamp is connected across the galvanometer and resistance and should an excessive voltage appear at the galvanometer terminals the lamp flashes over, placing a low resistance across the galvanometer to prevent damage.

The neon lamp and added resistance for the galvanometer may be mounted in a small box with suitable binding posts marked "line" and "instrument" and thus readily put in circuit when required.

• • •

*Secondary Distribution Economics**

II—Voltage Drop and Transformer Size

By E. M. ADKINS
Jersey Central Power & Light Company, Asbury Park, N. J.

Average size of transformers required is determined by the total length of secondary circuit and the average load density per unit length of secondary circuit. The total length of secondary circuit is determined by the conductor size, load density and maximum allowable voltage drop. These values will also be influenced by the type of secondary circuit. The secondary circuit may be a straight two-way feed, a two-way feed with lateral branches or a four-way feed and may be either single phase or three phase. The required transformer size will be determined for both single- and three-phase feed for the three types of secondary circuit shown in the accompanying illustration.

Straight two-way feed

Assume a straight two-way secondary circuit with the transformer located midway between street intersections as shown in (a).

The voltage drop of a low voltage circuit may be expressed with sufficient accuracy by the following equation:

Voltage drop = Amperes (r cos θ + x sin Θ). The quantity in parentheses may be called the effective impedance and is expressed by the term z. The voltage drop from A to B of (a) with a distributed load is therefore equal to the following:

$$V = \tfrac{1}{2}\cdot\tfrac{1}{2}\,(R\cos\theta + X\sin\Theta)$$

Where R and X is the total resistance and reactance from A to B.

The resistance and reactance from A to B is equal to the following, where r and x is the resistance and reactance per foot of wire and T is the total length of the secondary circuit in feet.

$$R = \frac{Tr}{2} \text{ and } X = \frac{Tx}{2}$$

The total transformer current I may be expressed in terms of the total length T and the load density D by the following equation:

$$I = \frac{TD}{1{,}000}$$

The maximum voltage drop of a two-way secondary circuit is, therefore, equal to:

$$V = \tfrac{1}{2}\cdot\tfrac{1}{2}\cdot\frac{TD}{1{,}000}\,\left(\frac{Tr}{2}\cos\theta + \frac{Tx}{2}\sin\theta\right)$$

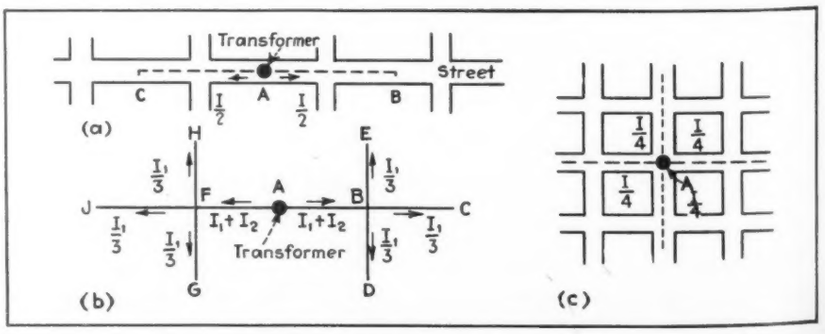
$$= \tfrac{1}{2}\cdot\tfrac{1}{2}\cdot\frac{TD}{1{,}000}\cdot\frac{T}{2}\,(r\cos\theta + x\sin\theta)$$

$$= \frac{T^2D}{8{,}000}\,(r\cos\theta + x\sin\theta) \text{ or,}$$

$$V = \frac{T^2Dz}{8{,}000} \text{ volts.}$$

The above equation for voltage drop is based on the assumption that a uniformly distributed load is to be served. The manner in which the equation can be modified to recognize definite blocks of load represented by each customer service from each pole will be covered in the next installment.

* Installment No. 2 in a series to continue in forthcoming issues of ELECTRICAL WORLD.



Three basic feeds from a transformer
(a) Straight two-way feed. (b) Symmetric two-way feed with laterals. (c) Four-way feed.

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Industrial ELECTRIFICATION

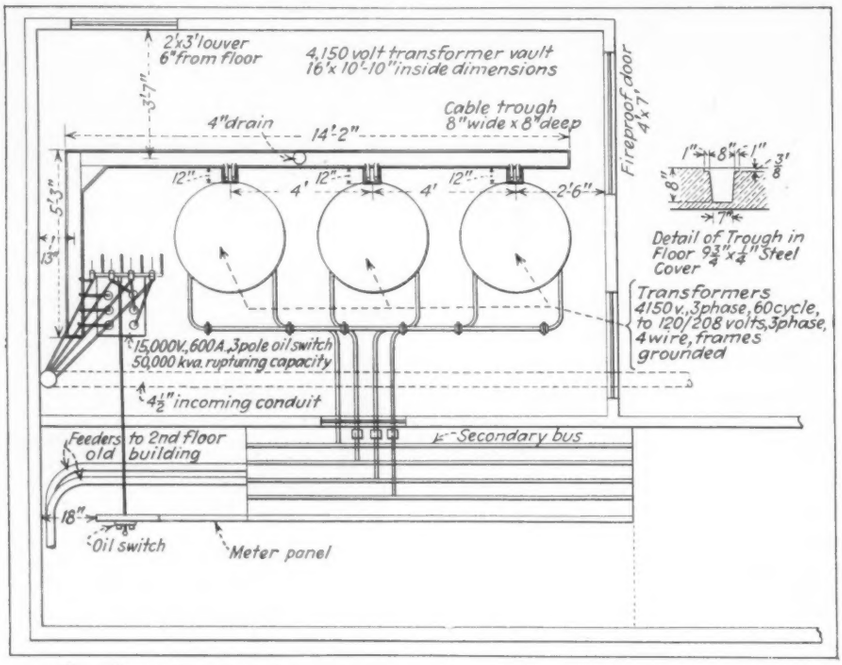
New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

Careful Vault Design Reduces Investment

When plant expansion made it necessary to build an extension on the spot occupied by the transformer bank serving the Rahway, N. J., plant of the Quinn & Boden Company a new location had to be sought for the power bank. To avoid paying a temporary connection charge of $370 to the Public Service Electric & Gas Company and shifting the bank to a temporary location to serve the plant during construction, the mat for the new vault was built first and the transformers shifted directly to it. Here they functioned as an outdoor substation until the plant construction was completed and walls could be built around them to form the vault.

In designing the vault insurance requirements were satisfied and the necessity of purchasing an expensive 4,000-amp. secondary main switch avoided by locating the 15,000-volt, 600-amp. primary oil circuit breaker within 2 ft. of the cable entrance and making the breaker operable from a readily accessible point on the main switchboard in the plant by means of a bell crank. An air-break isolating switch was installed between the oil breaker and the service entrance.

Elminate cable potheads by carrying cables through transformer primary bushings and connecting within case



Primary oil circuit breaker operated from main switchboard by bell crank avoids investment in large secondary main switch. Floor trough does away with need for primary cable rack

Further saving was realized by the elimination of primary, cable racks and potheads. Service cables from the oil circuit breaker to the transformers were laid in a shallow trough in the concrete vault floor. Potheads were eliminated by carrying the primary cable through the transformer primary bushings to the connection block within the case.

An additional saving was realized by using four-wire, three-phase distribution, thus permitting lighting to be taken off between one secondary phase wire and ground rather than making it necessary to purchase and install an individual lighting transformer. Electrical construction work on this vault was done by the Williams Electric Company, Inc. Vault design was worked out in conjunction with the local utility power representative.

•

Heat Solves Putty Problem

Keeping putty in a workable condition presented a problem at the plant of the Morgan Sash & Door Company, Chicago, until a "Dip" heating unit was put to work on the job. Both electric wire coils and fuel were tried—applied outside the tank—but results proved unsatisfactory.

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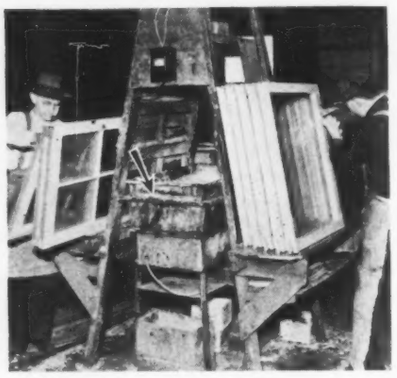
Further, the putty tended to heat only on the bottom of the container, with the result that part of it dried out and the rest was heated hardly at all.

A special, double-walled tank is used to hold the putty. The space between the walls of this tank is filled with water and a 4-kw. G.E. immersion heater raises the water to the correct temperature. No trouble is experienced in keeping a full 50-lb. batch of putty in condition for immediate use. Fire hazard is eliminated and heat losses have been reduced.



Electrically heated water jacket keeps putty at workable temperature

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Motor Overloading Saves Oil Well Money

By R. E. PATRICK
Kansas Gas & Electric Company
Wichita, Kan.

Because of the difficulty of accurately anticipating the power required for potential taking,* the ability of special electric motors to operate at either of two nominal horsepower ratings is of definite value to oil well operators. These special oil well motors are reportedly capable of operating with momentary overloads as high as 400 per cent and with continuous overloads of 25 per cent without stalling.

In one field served by the Kansas Gas & Electric Company an oil well operator has installed motors of this type having two nominal horsepower ratings, 15 hp. and 30 hp. Normally these motors operate as 15-hp. units, pumping at the rate of eighteen strokes per minute. These wells are equipped with 2½-in. tubing, 2¼-in. working barrel, pumping at a depth of 3,300 ft. When this company takes potential all that is necessary is to change the position of a double-throw switch on the motor to change its nominal rating to 30 hp. with a full load speed of 1,160 r.p.m. Upon checking several of these wells, pumping 36 strokes per minute with a 54-in. stroke, the measured input was 34½ hp. This input load, using a full load efficiency of 87 per cent, shows that the motor output was 30 hp., the higher nominal rating of the motor.

An adjoining lease with the same type well, using identical equipment, pumps normally with a 30-hp. multi-cylinder engine. When taking potentials it was necessary to move in a large pumping unit equipped with a 110-hp. multi-cylinder engine to do the same job the 30-hp. electric motor was doing.

The engine investment of approximately $4,800, plus the additional cost of moving the equipment from one location to another for potential taking, to be used only 40 hours every nine months, looks very expensive in comparison with the cost of electric motors of the size mentioned above, even when it is considered that the motors are of special design and therefore more costly than standard types.

* Potential-taking means pumping a well to determine the maximum output the well will produce. From this maximum output the well is then prorated to a certain output per month. In Kansas it is required to take a potential once every nine months. The method is to pump the well for eight hours. The tanks are gauged every four hours and the average of the four-hour periods is multiplied by six to get the total the well will produce in 24 hours.

Greeting Card Maker Uses Conditioned Air

Rust Craft Publishers, Boston, depend materially on air conditioning to insure freedom from troubles caused by excess humidity in printing and lithographic production. In color printing uniform results are even more important than in black and white work, precision being necessary to 0.001 in. or less. Close atmospheric control spells minimum stretching or shrinkage of paper, minimum trouble variations of ink in consistency, clean plates and uniform roller diameters, along with steady and reliable employee service. A 30 per cent increase in relative humidity may cause a 0.25-in. stretch in a 38 x 50-in. sheet of paper's length and 3/16 in. increase with the grain.

At the Rust Craft plant "year-round climate" is provided by an air-conditioning system consisting of a bank of filters, three 15-hp. refrigerating machines, cooling and heating coils and a 10-hp. fan which maintain 70 deg. temperature and 45 per cent relative humidity over a 20,000-sq.ft. area with ceiling height of 12 ft. The absence of dirt and maintenance of comfortable working conditions help maintain quality of product and employee efficiency. Outside weather has no material effect on internal operations and ability to repeat results in each batch of material reduces rejects and contributes to successful operation.

Air-conditioned engraving department of Rust Craft organization

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Below. Wagner 12,000 kva, 34,500 volt delta to 4500 volt star, forced air-blast, three-phase power transformer.

At the left is shown a Wagner 10,000 kva power transformer.

Left. Wagner 16,000 kva, single-phase, 115,000 to 13,200 volt, oil-filled, water-cooled power transformer.

● Power transformers are the responsible servants essential for the unfailing transmission of electric power. Wagner power transformers give unfailing service, because: (1) they are literally designed with extra factors of safety, (2) materials and parts are carefuly selected and pre-tested, (3) the latest production methods are utilized in their construction, (4) the very latest developments are embodied in their design after considerable engineering research, (5) only carefully trained workmen are used for their manufacture, and (6) all completed transformers are subjected to rigid and comprehensive engineering and commercial tests before shipment to customers. Utility companies will find it to their advantage to give Wagner an opportunity to quote on their next power transformer installation. In the meantime let us send you Wagner Power Transformer Bulletin No. 181.

TP238-3B

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MOTORS TRANSFORMERS FANS BRAKES

New ENGINEERING IDEAS

Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

Electronic Device Speeds Up Counters

By E. M. PRITCHARD
United Cinephone Corporation,
Long Island City, N. Y.

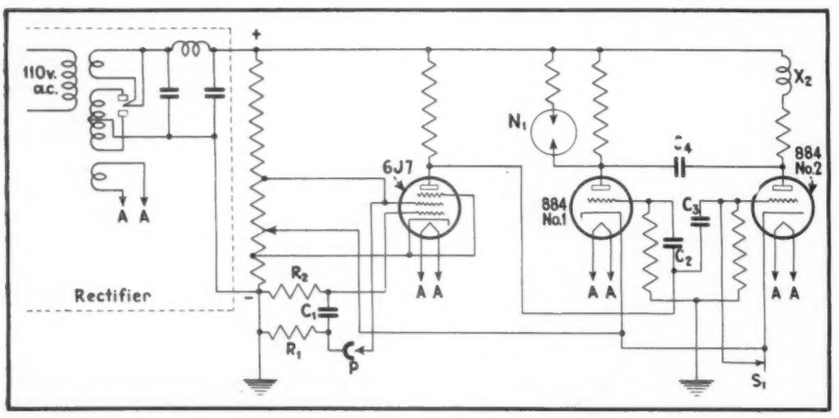
Routine counting of articles in industry by photo-control equipment is commonplace. However, it is occasionally desired to count a small product issuing from an automatic machine into containers or packages at a speed greater than conventional photo-controls or magnetic counters will operate.

Two types of electronic multiplier circuits have been devised which, when placed between the photo-electric cell and the counter, furnish one impulse to the counter circuit for some definite predetermined number of impulses in the photocell circuit. The first or "storage" type of circuit is desirable at speeds above about 2,000 per minute, whereas for speeds less than 2,000 per minute the "inverter" type circuit is somewhat simpler.

The second type of circuit has been developed and built as a "ratio differential counter," which in its simplest form furnishes one impulse to the counter for each two impulses of the photocell circuit. The fundamental circuit, with a single coupling tube from photocell to the ratio circuit, is shown in the accompanying diagram. Its operation is exceedingly simple.

The photocell and load resistance, P and R_1, are fed from the 90-volt screen tap of the bleeder. Interruption or decrease in the amount of light falling on the photocell decreases the photocell current in R_1, feeds a negative pulse through coupling condenser C_1 to the grid circuit and resistance R_2 of the 6J7 amplifier. The fixed grid bias is sufficiently low to permit the 6J7 plate to operate only slightly above cathode potential. When the grid is suddenly swung negative the anode current is decreased, causing a sudden rise in anode potential, which appears as a positive pulse on the grid side of the two coupling condensers C_2 and C_3. The two 884 tubes are grid-controlled, argon-filled rectifiers and are connected in what is essentially a two-tube parallel inverter circuit. One or the other of the tubes is always conducting. Assuming that tube 1 is conducting, the positive pulse will "fire" tube 2, dropping the anode potential to cathode potential plus the arc drop of 15 volts. Commuting condenser C_4 drops the anode potential of tube 1 a like amount, and if the time constant of the anode circuit is sufficient, tube 1 will be extinguished and its anode will recover to the potential of positive plate supply. When the next positive pulse arrives tube 1 will be fired, extinguishing tube 2 and completing the cycle. A load such as a counter coil connected in the plate circuit of tube 2 at X_2 will be energized once for every two impulses in the photocell circuit, and if the impulses arrive at a uniform rate the counter will be energized and de-energized for equal length of time, permitting maximum counting speed. Many counters (such as Veeder-Root) can be supplied with 220-volt d.c., windings; if other windings or other types of load are to be energized a relay may be substituted for the counter coil.

In order to facilitate the zero setting and insure a count accurate to one impulse a reset switch S_1 and a neon lamp N_1 are connected as shown. If a direct reading count is desired, without the multiplying factor of 2, the units wheel of the magnetic counter should be marked 2, 4, 6, 8, 0, 2, 4, 6, 8, 0, instead of the conventional 1 to 0.



Circuit doubles speed of counting machines

•

Speed Changer Uses Vari-Pitch Scheme

A new speed-changing device utilizing principles of the Vari-Pitch sheave has been developed by the Texrope Division of the Allis-Chalmers Manufacturing Company, Milwaukee, Wis., to meet the demand for a compact and flexible unit in a variety of industries.

The device consists of a pair of shafts on which are mounted two deep-grooved Vari-Pitch sheaves adjusted through a worm and worm wheel, operated either manually by means of a hand wheel or electrically through a fractional-horsepower motor controlled through a forward and reverse push button. The Vari-Pitch sheave consists of movable V-shaped plates mounted on a shaft to permit the Texrope V-belt to ride higher or lower in the groove, thus

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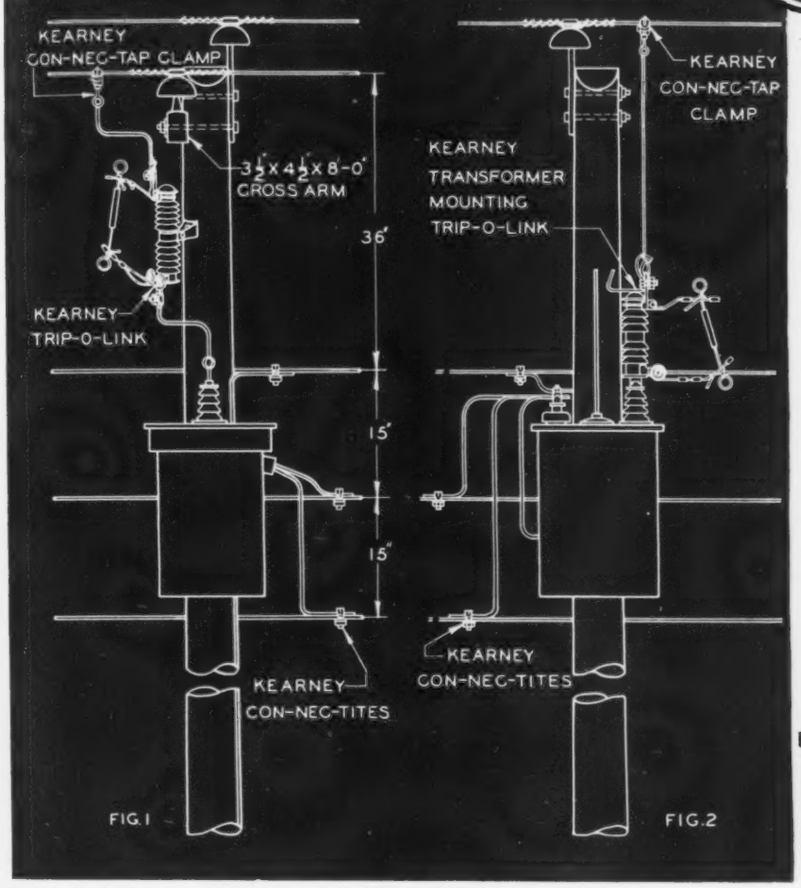

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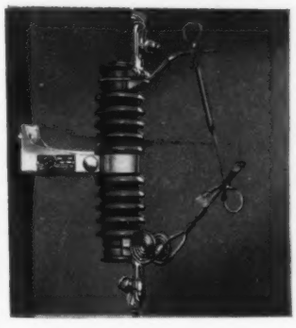

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Costs had to be held down on rural extensions — yet, good, dependable service was necessary . . . Cheap, make-shift constructions would not do. . . . Then, came the construction, here shown. Kearney Trip-O-Links, for mounting direct on poles or cross-arms, solved one immediate problem. See figure 1. Where necessary, Trip-O-Links with adapters were mounted directly on transformer bushings (figure 2) — again effecting dependable protection to equipment at exceptionally low cost.

Here's a company that realized that by specifying standard Kearney Trip-O-Links and combinations, they could mount these switches on either poles or cross-arms, without changing hangers. . . . They also realized that installation of new fuses in Trip-O-Links, provided a complete new cartridge — a new switch, in the fine sense of the word.

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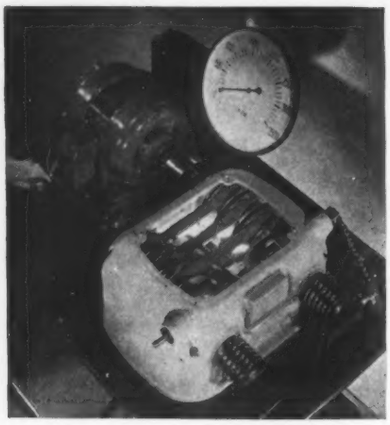


Apply Vari-Pitch sheave principle to development of speed-changing unit

Demonstration unit with 1,800 r.p.m. direct-connected motor and electric remote control

producing a larger or smaller sheave diameter and resulting in a change of speeds.

The changer can be operated at high speeds, permitting the use of a direct-connected motor. To assure proper alignment of the coupling, a base common to the motor and speed changer is advisable. Double shaft extensions permit the unit to be driven from either side or either end. Where the unit is driven by a Texrope drive it is feasible to eliminate the sub-base and coupling ordinarily required for direct connection. By selecting a drive of the proper ratio the constant speed shaft can be run at the proper number of revolutions per minute to obtain the desired speed range on the output shaft. Seven sizes are being made available, covering a range of from 1 to 33 hp., with a speed range of 3.75 to 1, and running approximately between 300 and 3,600 r.p.m.

Use Open Core Design in Test Transformer

An entirely novel design of a very high-voltage, commercial frequency transformer for testing purposes has recently been developed by the A.E.G., Berlin. The new testing transformer, with a ratio of 1,000 to 1,000,000 volts, has a reactance of only 15 per cent for an output of 500 kva. and weighs complete only 10 tons.

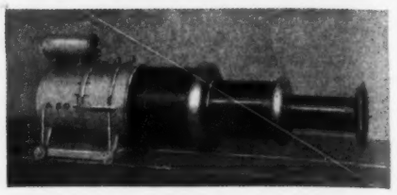
The iron core of the transformer is a single straight, center leg without closed magnetic return. Concentrically around this core are arranged three layers of high-voltage, barrel type coils so connected that the outermost layer is tied to the tank and is therefore at ground potential, while the innermost layer is connected to the iron core. The latter represents and is metallically connected to the high-voltage lead.

The low-voltage excitation winding is on the outside of the high-voltage winding next to the tank wall. To aid in the magnetic flux return and to prevent heating of the steel tank the outside of the windings is surrounded by a thin sheet steel shell.

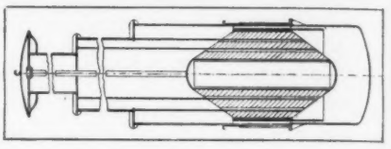
Normally, a transformer with open iron core would have excessive inductive losses. However, by a carefully arranged winding, such a high internal capacity was reached that for average load a large part of the inductance is compensated.

The high-voltage lead is of the condenser type, connected at three points to the winding.

Instead of the customary large spherical or toroidal top terminal, this transformer lead ends in a sharp-edged disk. It is pointed out that the customary ball terminal is of no particular use, since connection to the tested object is made with a thin wire, which defeats the purpose of the corona-free terminal. The design was described in *Elektrotechnische Zeitschrift* of March 3.



When not in use the 10-ton 1/1,000-kv. test transformer can be rolled out of the way



Design of high-voltage test transformer involves cylindrical core without magnetic return

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Study Current Flow At 450 Below Zero

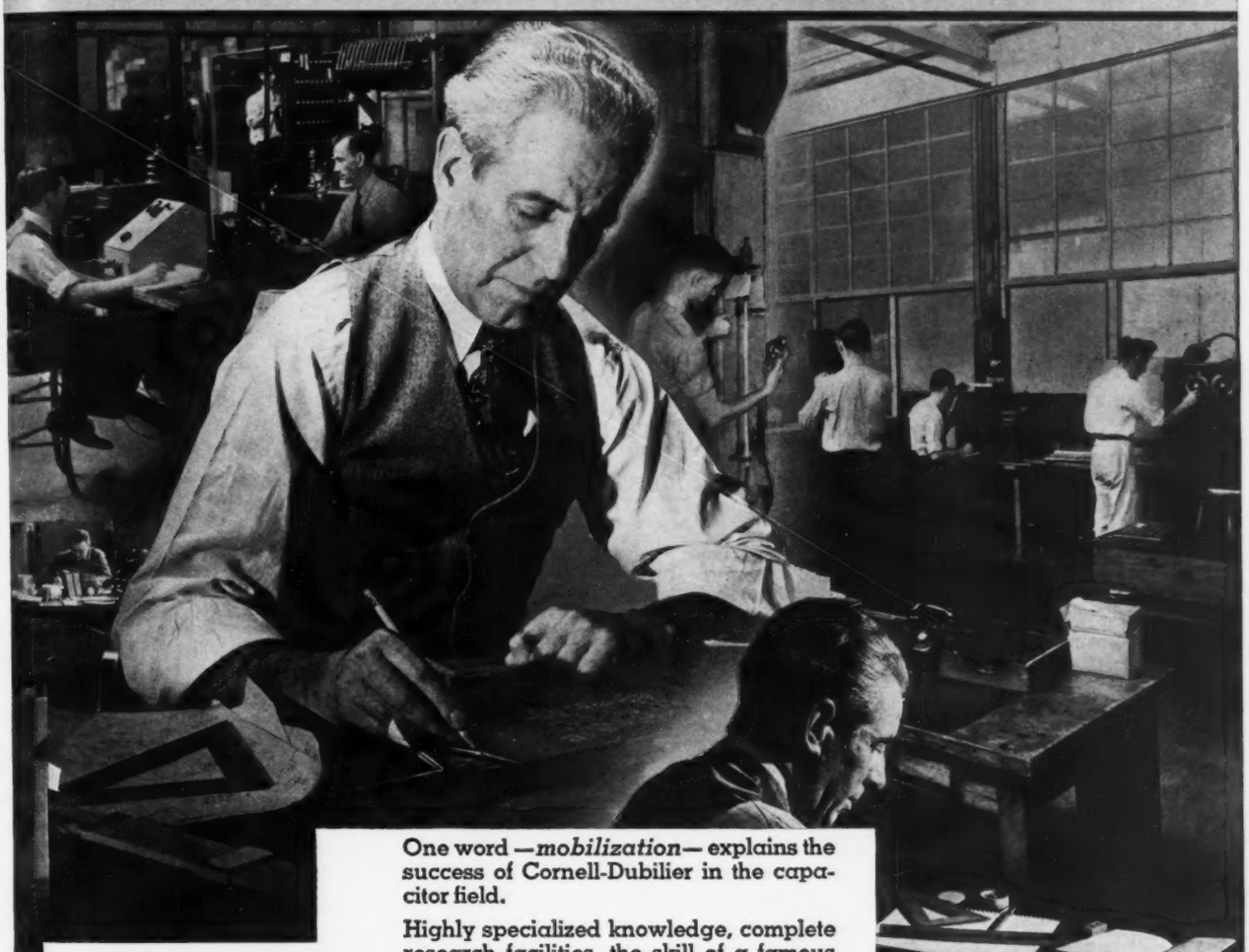
The well-known experiment indicating that current set up in a closed loop of wire at absolute zero (—459.4 deg. F.) will flow continuously was carried one step further recently by physicists of the U. S. Bureau of Standards in order to demonstrate that the current flowing was associated with the lightest weight particles of matter and thereby to provide experimental evidence that the particles are electrons.

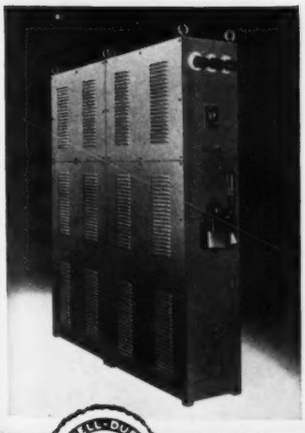
Current set up in a tin wire at —450 deg. F. was extinguished in 5 microseconds by a momentary magnetic field around the wire. The wire, 0.9 in. thick, was coiled in a small chamber and cooled by liquid helium to —450 deg. F. The high speed at which the magnetic field was switched on and off was considered too fast to effect any but the lightest particles and the fact that the current was extinguished in five millionths of a second by the action of this momentary field was considered evidence that the particles flowing were extremely light. The magnetism presumably caused the particles to spiral and bump into each other. Energy of the disappearing current was turned into heat.

GLASS TAPE INSULATION UNDERGOING FIELD TESTS

Glass tape insulation in heavily overloaded traction motors operating at high temperatures is successfully undergoing severe field tests. Coils insulated with the tape, which is made from fine strands of pure glass, have been installed in mine motors and motors in street cars and electric locomotives. H. R. Meyer, transportation department, Westinghouse Electric & Manufacturing Company, is here holding a blow torch to the winding on a coil to prove that it is fireproof. Glass tape can be shown to survive high temperatures without losing its mechanical characteristics. Its mechanical and dielectric strengths are high and it does not rot or decay. It is moisture and acid proof, insulation resistance is very high. It can be obtained in thicknesses as low as 0.005 in.

MOBILIZATION





One word —*mobilization*— explains the success of Cornell-Dubilier in the capacitor field.

Highly specialized knowledge, complete research facilities, the skill of a famous engineering staff, plus a vast fund of experience — all these are mobilized at Cornell-Dubilier in producing a *dependable* capacitor for power-factor improvement.

Time has more than proven the soundness of Cornell-Dubilier's twenty-eight year old policy of specialization. In trustworthiness, in continuous year-after-year capacitor use, C-D means more capacitor value per dollar. Literature on request at Dept. D23. 1032 Hamilton Boulevard, South Plainfield, N. J.

UTILITIES ARE FINDING IN CORNELL-DUBILIER POLE-TYPE CAPACITORS THE ANSWER TO THE PROBLEM OF INCREASING SYSTEM CAPACITY ECONOMICALLY.

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Capacitors for Power-Factor Correction

Building Up THE LOAD

New ideas and practices in selling electrical equipment and service to commercial and domestic customers

Unusual Rural Uses on West Coast

By PROF. B. D. MOSES
University of California, in broadcast over WGY and W2XAF of General Electric Company.

Sometimes, where there is a great deal more electricity generated than is used, the companies promote the use of new appliances, or develop new uses for the old. They want to increase the consumption of the existing lines until they are loaded to capacity, and are serving as many customers as possible. This is what has taken place in California, and this is why the power companies have carried on very active programs for rural electrification.

You are, no doubt, familiar with the general uses of electricity on the farm, and so I would like to mention a few of the unusual applications:

The citrus growers of California are using the X-ray in the inspection of oranges, lemons and grapefruit. The fruit passes in a continuous stream on endless belts over an X-ray machine. The inspector, by viewing the picture on the screen, is able to pick out the defective fruit.

Turkey raisers in the San Joaquin Valley have found that they can raise splendid turkeys, healthy and strong, with low mortality losses, by using soil-heating cable to heat the sand floors in their brooders.

One woman near Los Angeles claims to have been able to protect her orange trees against frost by hanging incandescent lamps in the trees.

Artichoke growers at Half Moon Bay, near San Francisco, use electrocuting traps to combat a small moth that damages their product.

Honey producers move their hives into the mountains during certain seasons of the year and are now experimenting with the electric fence to protect them from the ravages of the ever-hungry mountain bear.

Large electric fans are used by the orchardists to protect their trees against the frost.

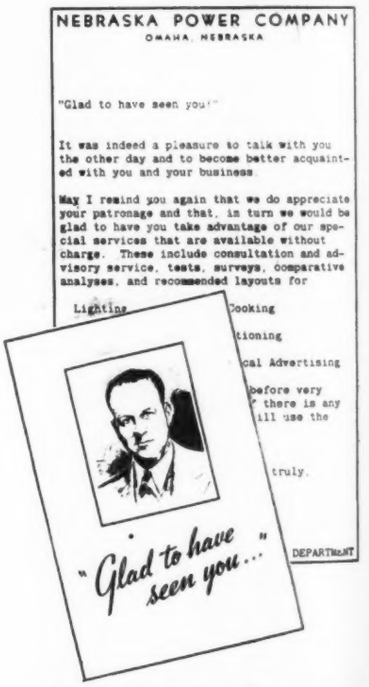
Several dairies have installed radios in the milking barns to relieve the milkers of some of their drudgery, and they like it.

In glancing over the situation, then, we find that electricity is wanted, if it can be made available at a reasonable cost. We have found, too, that one use promotes another and that there is generally one basic application which acts as a foundation upon which other uses are built. In California, this basic load has been the irrigation pump for agriculture, the electric light for the small rural town, and the factory motor for the industrial areas. I found one place, here in the east, where the power company considers the electric brooder and the milk cooler as the loads that will introduce electricity to the farm and rural home.

•

"Glad to Have Seen You" Sales Reminder

Successful power selling depends largely on friendly relations between salesman and customer. The salesman strives to build up such relations because he knows that the customer will not like, nor have confidence in, the utility unless it feels the same way toward him. As a help toward maintaining the friendly interest of the customers for whom they are responsible, the power salesmen of Nebraska Power Company, Omaha, Neb., are supplied with personalized reminders which are sent to customers a few days after calls are made. The remainder is a four-page mailing piece on the cover of which are the words "Glad to have seen you" below a picture of the salesman. On the right-hand inside page is a printed letter addressed to the customer and with a holographic signature of the salesman; that is, actually written in every letter. On the opposite (left) page are four pictures and captions illustrating applications of electricity to lighting, power, air conditioning and commercial cooking. The letter reads:


NEBRASKA POWER COMPANY
OMAHA, NEBRASKA
"Glad to have seen you!"
It was indeed a pleasure to talk with you the other day and to become better acquainted with you and your business.
May I remind you again that we do appreciate your patronage and that, in turn we would be glad to have you take advantage of our special services that are available without charge. These include consultation and advisory service, tests, surveys, comparative analyses, and recommended layouts for
Lighting
Cooking
tioning
cal Advertising
before very
there is any
ill use the
truly.
DEPARTMENT
"Glad to have seen you..."

Power salesman's call reminder, mailed to customer four days after the salesman has made his call

It was indeed a pleasure to talk with you the other day and to become better acquainted with you and your business.

May I remind you again that we do appreciate your patronage and that, in turn, we would be glad to have you take

TAKE AWAY THAT SQUINT!

Improve Lighting Conditions In Your Plant With Pittsburgh Glorified Light Paints

BEWARE OF that harmful, sight-destroying squint on your men. It is the result of improper lighting and means lower efficiency, increased accidents, slower production—*money out of your pocket!* Do away with it!

Correct this costly condition immediately — spread proper, helpful illumination throughout your plant with Pittsburgh's famous Glorified Light Finishes.

Leading authorities on light control, working with Pittsburgh Paint engineers, have perfected the three Glorified Light Systems. These scientifically prepared paints diffuse and reflect all available raw light—whether natural or artificial—and turn every foot candle power into cheerful, profitable illumination.

Get the facts. Bring proper, balanced lighting to *your* plant—with Pittsburgh Glorified Light Paints. There is a finish for every type of factory lighting condition. You will find that these Glorified Light Systems more than pay for themselves in a short time. Get the full information. Send for Pittsburgh's "Glorified Light" Book. Clip coupon *right now!* Pittsburgh Plate Glass Company, Paint Division, Pittsburgh, Pennsylvania.

Copr. 1938 Pittsburgh Plate Glass Co.

THERE IS A GLORIFIED LIGHT PRODUCT FOR EVERY TYPE OF FACTORY!

THE SNOLITE SYSTEM will bring profitable Glorified Light into any plant with normal interior surfaces.

THE SNOTEX SYSTEM is specially designed for all abnormal interior surfaces except those affected by fungus growth. It resists discoloration from humidity, fumes, gases and lack of daylight.

THE FUNGUSIDE SYSTEM effectually retards the growth of fungus. It is vitally necessary in bakeries and food factories—wherever fungus presents a serious problem.

Pittsburgh Plate Glass Company
Paint Division, Dept. EW4,
Pittsburgh, Pennsylvania

Please send me free your book, "Glorified Light".

Name _____

Address _____

City _____ State _____

PITTSBURGH PAINTS

COMPLETE LINE OF STRUCTURAL MAINTENANCE FINISHES

Smooth as Glass

advantage of special services that are available without charge. These include consultation and advisory service, tests, surveys, comparative analyses and recommended layouts for

Lighting	Commercial Cooking
Power	Air Conditioning
Heating	Electrical Advertising

I want to call on you again before very long, but in the meantime, if there is any way we can help, I hope you will use the telephone and let me know.

•

Adequate Wiring Aids Lighting Sales

By LESTER TWICHELL
Supervisor, Lighting Service, Rochester Gas & Electric Corporation, Rochester, N. Y.

In providing services for both automobile and driver, electricity is a very important ally of the service station operator. It pumps the gasoline, supplies compressed air for tires and lubrication equipment and maintains a supply of hot water as well as lighting up the grease and wash racks, office and washrooms, pumps, signs, building exterior and driveways.

In many stations half of the sales are made under artificial light. The progressive operator makes his station attractive after darkness falls because a well-lighted station continually holds out an alluring invitation to stop and buy. More than that, a properly lighted station stands out more at night than it does in the daytime because of its contrast with dark surroundings. This night advertising carries over to the daytime trade. This was proved by a large chain that experimented with the effect of alternately lowering and raising the lighting level of their stations. They found that with the lowered lighting *both* night and day sales fell off 30 per cent.

Many of our local service stations have recognized the value of this advertising and have modernized their lighting accordingly. One of the large established chains has specifically set aside a large sum for the addition of better lighting. This action results partially from a comprehensive wiring and lighting survey made over a year ago by the members of our lighting service division.

This chain has greatly improved the lighting of its better located stations by using two 1,000-watt floods per pole, where they used one before. This has been further supplemented by the extended use of island lights.

Inadequate wiring handicaps

The survey revealed that in most of the stations the none-too-adequate lighting equipment was further handicapped by inadequate wiring. No skimping was done when most of the stations were built, but the lighting specifications were limited to stating the number of circuits to be provided and that all wiring must be in accordance with the National Electrical Code. As a result practically all of the wiring was No. 14 gauge, irrespective of length of run. We often found 105 volts at the socket of a 120-volt floodlight lamp with its consequent inefficient operation. This particular chain now draws up its wiring specifications so that adequate wiring is assured. Just one little detail that converts more electrical energy into light and makes their new stations much easier to stop at after darkness falls.

This small station's connected lighting load includes four 1,000-watt Wheeler open floodlights and four 500-watt Goodrich island lights

•

Meter Readers Check Saturation Records

Keeping track of appliance saturations by recording their own sales and adding to them the sales of dealers has frequently led utilities into errors of load-building promotion. The estimate as to the number of refrigerators in service, for instance, was too high or too low, and consequently the sales plan was out of line in one or the other direction. Yet records of appliance saturations by compilations of dealer and company sales can be accurate if real effort is made to keep them so by close checking of trade-ins, of resale of trade-ins and of sales outside the company's service territory. Proof of this appears in a recent check made by the Central Illinois Electric & Gas Company in Rockford, Ill.

In 1933 the company made a survey of refrigerator saturation on its lines. Since then the figures have been kept up to date with the cooperation of dealers who supply regular reports of their refrigerator sales. As of January 1, 1938, this record showed 14,097 refrigerators among 27,895 domestic customers, a saturation of 50.5 per cent. Apprehending how prone such records sometimes are to stray into error, the company decided to check the refrigerator figures. This was done in December, 1937, by meter readers, who were instructed to determine and report customers without refrigerators. The figures the readers turned in totaled 13,802, which, subtracted from 27,895, the number of domestic customers, showed 14,093 with refrigerators, a difference of only four from the continuous record.

"Sure, I'm a TOUGH GUY ... sometimes!"

"I saw an advertisement run by The Associated Business Papers that pictured me as typical of the prospects that advertisers' salesmen classify as 'tough guys.' The ad went on to say that while I am tough when salesmen call, I am pretty regular when I am reading an A.B.P. publication. Well, I don't resent it a bit. With so many keen salesmen calling on me every day, I have to pretend to be hard-boiled most of the time.

"But you can be sure that I put aside that 'protective mask' when I am reading ELECTRICAL WORLD because that is where I go to keep in touch with trends and developments; for practical ideas suggested by an editor who is familiar with my business. I know that ELECTRICAL WORLD is written for *me*, not for its advertisers. Yet I read the ads, too, because I know that they are in there only because they have something to offer — not because they got editorial publicity.

"I pay cold cash for my subscription to ELECTRICAL WORLD and you can bet I wouldn't do it unless I get my money's worth."

News ABOUT PEOPLE

Pearson Assumes New Duties with Pacific Power & Light

E. F. Pearson, formerly chief engineer of the Northwestern Electric Company, Portland, Ore., has relinquished the duties of that position to become assistant to Paul B. McKee, president of the Pacific Power & Light Company, Portland. In his new posi-

tion his services will be available in an advisory capacity to the Northwestern Electric Company. The engineering department of that company has been consolidated with the operating department under Walter J. Dennis, assistant general manager.

Mr. Pearson became associated with Northwestern Electric in 1912, the year in which that company entered the utility field. At first his work was in the engineering and construction department. Subsequently he was made electrical engineer and in 1935 chief engineer. He obtained his engineering education at the University of Nevada.

He has long been active in the Northwest Electric Light & Power Association. Once he served a two-year term as chairman of the engineering and operation section and at the present he is chairman of the transmission and distribution committee. He has also been active in the affairs of the American Institute of Electrical Engineers, this year being general chairman of the Pacific Coast convention to be held in Portland in August.

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▶CLYDE A. TURNER, formerly a member of the engineering department of the then Charles H. Tenney & Company organization, Boston, Mass., has been appointed general manager of the Concord (N. H.) Electric Company. He succeeds Levin J. Chase, who has retired after a long period of notable service in which the cultivation of excellent public relations brought him an outstanding reputation in the New England utility field.

▶WILLIAM J. MARLOWE, industrial power sales engineer of the Fitchburg (Mass.) Gas & Electric Light Company, has resigned to become general manager of the Fitchburg & Leominster Street Railway, a transit property which pioneered in the utilization of trolley coaches. His headquarters will be at Fitchburg.

▶COL. JOHN P. JACKSON, for many years in charge of personnel for the Consolidated Edison Company of New York, Inc., and the former New York Edison and United Electric Light & Power companies, was the guest of honor at a dinner given recently at the Waldorf-Astoria Hotel by his associates upon his retirement from the Consolidated System. Colonel Jackson has been in the electrical industry since he began as a wireman in the Sansom Street plant of the Philadelphia Electric Company in 1889. Later he went with the Sprague Electric Company as superintendent of street railway construction. He joined the New York Edison Company as assistant to Vice-President John W. Lieb in 1924 and two years later was also made manager of the personnel bureau. He has headed the Consolidated Edison personnel department as director since January last year. He is the joint author of a book on "Alternating Current and Alternating Current Machinery" and another on "Elementary Electricity and Magnetism."

Charles E. Carey to Direct Bonneville Construction

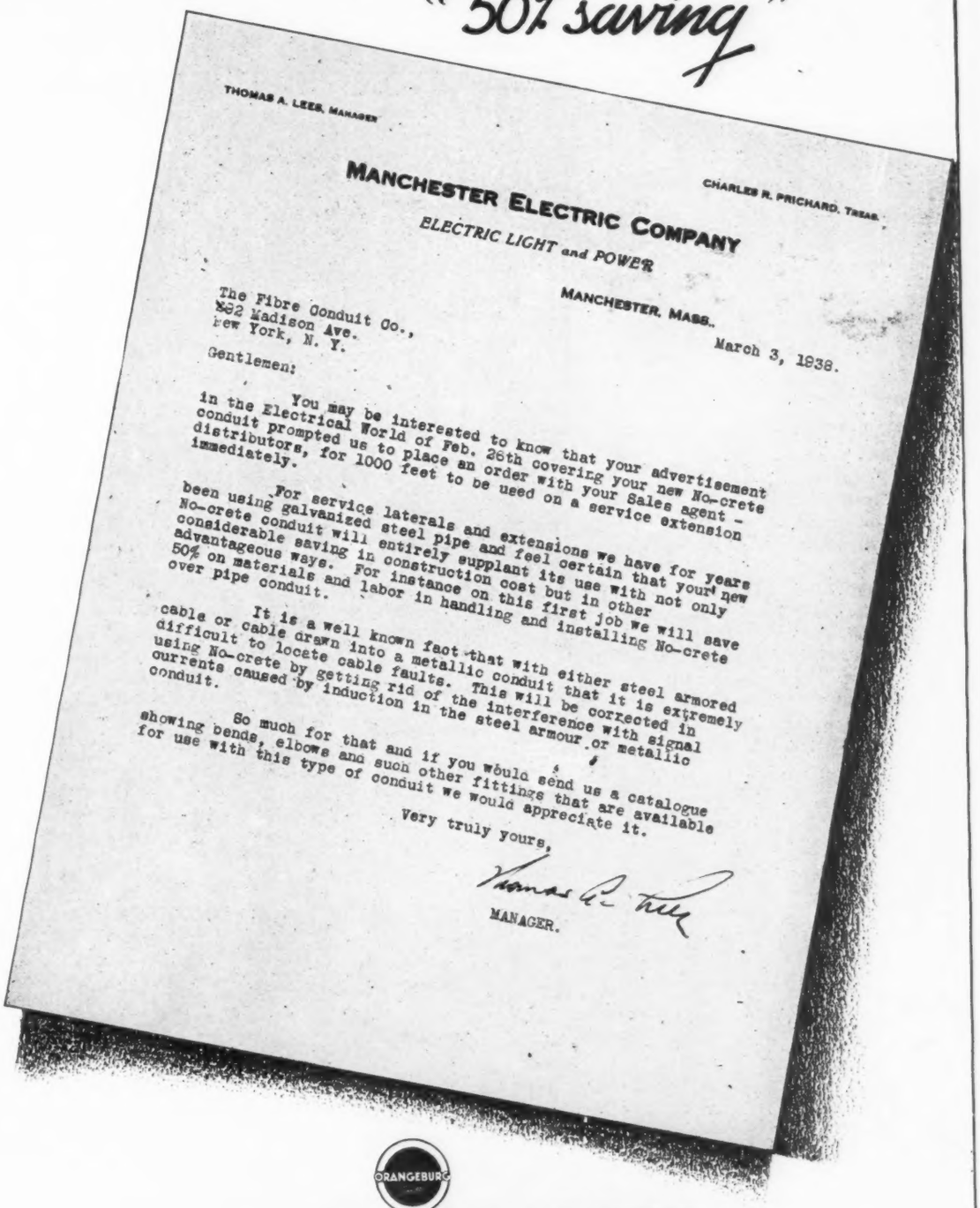
Charles E. Carey, of the engineering staff of the Bonneville administration office, Portland, Ore., has been promoted to be principal construction engineer in charge of all engineering and construction for the Bonneville administration under J. D. Ross, Administrator. Mr. Carey is best known to the electrical industry through his association with Westinghouse Electric & Manufacturing Company as engineering supervisor for the Northwest with headquarters in Seattle, a position he held from 1924 to 1934. Since that time, and until his employment with the Bonneville administration about the first of the year, he engaged in private consulting practice doing work for the W.P.A. in Seattle, National Resources Committee in Portland, and the Schulman Electric Company on the

construction of the new Skagit 220-kv. transmission line in Seattle.

Before his association with Westinghouse in 1923 in East Pittsburgh he was connected with the staff of the University of New Mexico for three years as professor of electrical engineering. His own degree in electrical engineering was obtained at the University of Oklahoma.

A UTILITY MANAGER WRITES:

"50% saving"



THOMAS A. LEES, MANAGER

CHARLES R. PRICHARD, TREAS.

MANCHESTER ELECTRIC COMPANY

ELECTRIC LIGHT and POWER

MANCHESTER, MASS.

March 3, 1938.

The Fibre Conduit Co.,
292 Madison Ave.
New York, N. Y.

Gentlemen:

You may be interested to know that your advertisement in the Electrical World of Feb. 26th covering your new No-crete conduit prompted us to place an order with your Sales agent - distributors, for 1000 feet to be used on a service extension immediately.

For service laterals and extensions we have for years been using galvanized steel pipe and feel certain that your new No-crete conduit will entirely supplant its use with not only considerable saving in construction cost but in other advantageous ways. For instance on this first job we will save 50% on materials and labor in handling and installing No-crete over pipe conduit.

It is a well known fact that with either steel armored cable or cable drawn into a metallic conduit that it is extremely difficult to locate cable faults. This will be corrected in using No-crete by getting rid of the interference with signal currents caused by induction in the steel armour or metallic conduit.

So much for that and if you would send us a catalogue showing bends, elbows and such other fittings that are available for use with this type of conduit we would appreciate it.

Very truly yours,

Thomas A. Lees

MANAGER.

ORANGEBURG

ORANGEBURG NOCRETE

FOR INSTALLATION UNDERGROUND WITHOUT CONCRETE ENCASEMENT

THE FIBRE CONDUIT COMPANY • Sales Office 292 MADISON AVENUE, N. Y.

Sales Agent—Distributors

GRAYBAR ELECTRIC COMPANY, INC. **GENERAL ELECTRIC SUPPLY CORP.**

Westinghouse Executives' Responsibilities Revised

The three Westinghouse vice-presidents who were assigned new duties recently in a revised schedule of re-

Ralph Kelly

sponsibilities have all been associated with Westinghouse interests for many years.

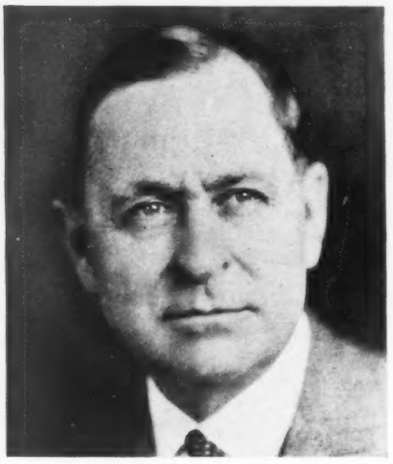
Vice-President Ralph Kelly, who recently was placed in charge of sales of the company with headquarters in the Pittsburgh executive offices, has been with Westinghouse since 1909, the year he was graduated from Harvard University. For many years he was associated with engineering departments of the company, then, in 1930, he became manager of the southwestern sales district. Later he went to Pittsburgh as manager of the sales

R. B. Mildon

district and in 1934 he was elected a vice-president.

R. B. Mildon, who was in charge of the steam and stoker departments of the company with headquarters in the South Philadelphia Works, until his recent assignment to the management of the East Pittsburgh division, became special mining engineer to George Westinghouse in 1906. Until 1915 he was associated with the Westinghouse Machine Company, then was appointed general manager of the company's stoker department with headquarters in Philadelphia. He was elected vice-president in 1934 taking charge of the steam and stoker departments.

Vice-President N. G. Symonds, who will now devote his time in the sales department to specific customer activities, association work and special duties as assigned, joined Westinghouse in 1902. For many years he was located in the Chicago district and in 1921 was appointed manager of the sales



N. G. Symonds

offices there. After his election as vice-president in 1932 he transferred his headquarters to Pittsburgh where he has since been engaged in sales operations.

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▶ ROBERT H. COLEMAN of the Consolidated Gas, Electric Light & Power Company of Baltimore, has been named a member of the new industrial committee of the Baltimore Safety Council.

OBITUARY

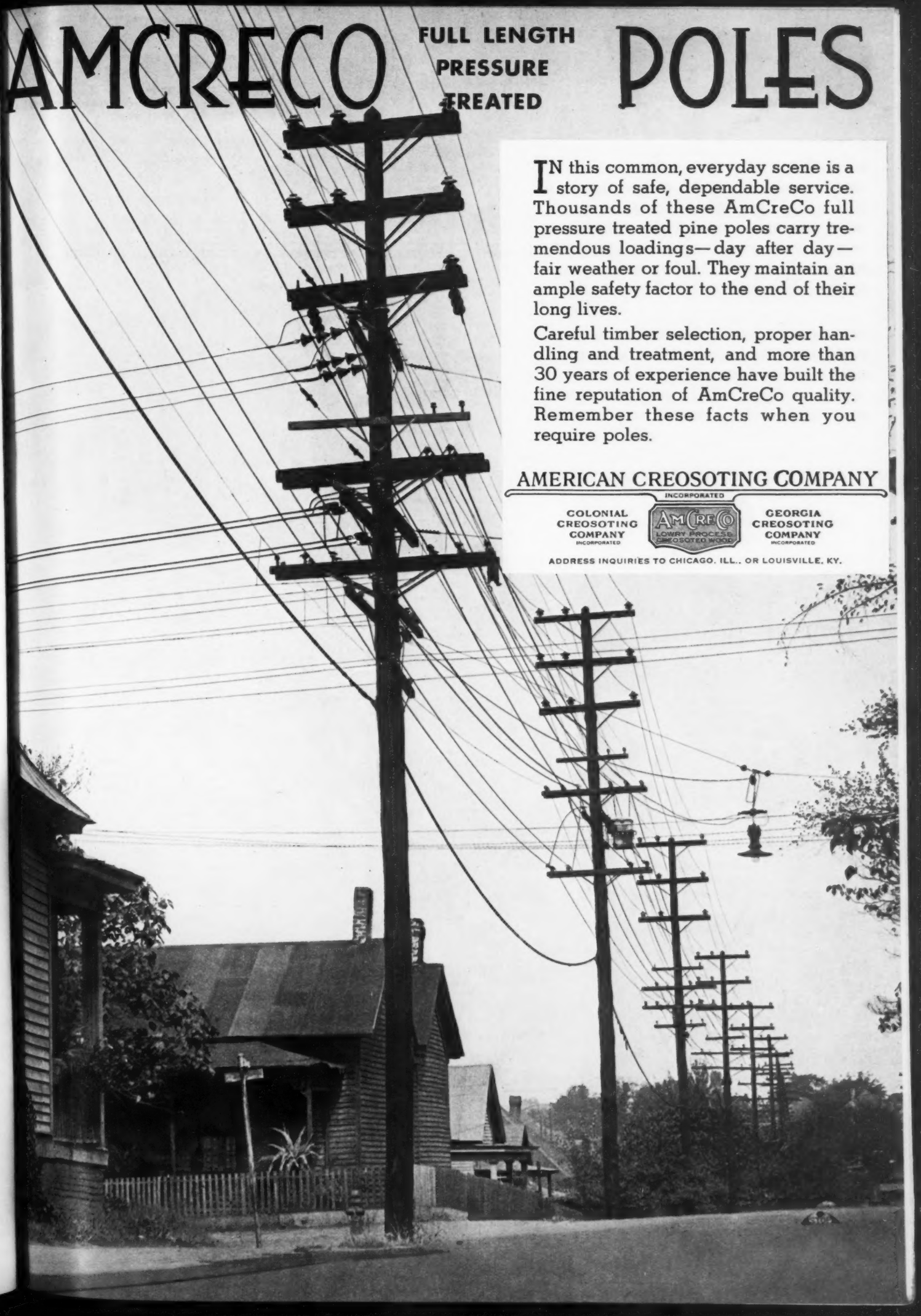
▶ HENRY W. TAYLOR chief turbo-generator designer for the British Thomson-Houston Company, Ltd., Rugby, England, died February 1. Mr. Taylor was born in London in 1883 and received his technical education in mechanical and electrical engineering at the city of London Guild's Technical College. In 1903 he became technical assistant to Dr. S. P. Thompson and held that position for three years before becoming a designing engineer for the British Thomson-Houston Company. He served that organization for almost 30 years, first as a designing engineer, later as an engineer in the turbo-generator department and as chief of that department.

▶ JAMES E. FRANK, for the past 30 years superintendent of distribution for the Haverhill (Mass.) Electric Company, died suddenly at his home in Haverhill on April 10 at the age of 55.

▶ LOGAN T. WOOD, vice-president and general manager of Gar Wood Industries, Inc., died March 28 in a San Francisco hospital. Mr. Wood was stricken suddenly with pneumonia during a business trip on the west coast.

▶ WINFRED MORRILL, associate electrical engineer, procurement division, United States Treasury Department, Washington, D. C., died recently. Following a brief affiliation with the Western Union Telegraph Company, he became an electrician for Stone & Webster in 1912. Between 1914 and 1920 Mr. Morrill held various engineering positions with the Stone & Webster company and with several manufacturing organizations. In 1932 he was transferred to the Potomac Electric Power Company, Washington, D. C., returned for a short time to the employ of Stone & Webster in the same year, and in the following year he entered the employ of the Virginia Electric & Power Company at Williamsburg. He was appointed to the United States Treasury Department in 1935.

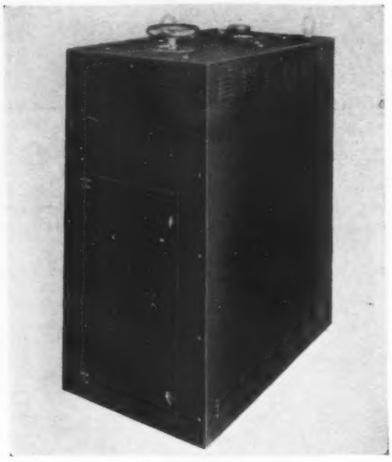
▶ JAMES S. ARBUCKLE, well-known electrical engineer of Montreal, Que., Canada, died February 4. Early in his career Mr. Arbuckle was connected with the Scintilla Magneto Company, New York, N. Y., relinquishing his association with that organization when the American Brown-Boveri Electric Corporation was formed at Camden, N. J. At that time he was appointed consulting engineer on mercury-arc rectifiers for the American Brown-Boveri Corporation, and later went to the home offices of the company in Switzerland. Following one year as professor of electrical engineering at North Carolina State College, Mr. Arbuckle was associated briefly with the MacDonald Engineering Corporation, Philadelphia, as an efficiency engineer. Later he returned to the Brown-Boveri corporation when that organization established Canadian offices in Montreal. When the Swiss Electric Corporation, Ltd., was organized as a Canadian subsidiary of Brown-Boveri, he became consulting engineer and general sales manager. Mr. Arbuckle was a member of the Engineering Institute of Canada and of several other engineering societies.


AMCRECO
FULL LENGTH
PRESSURE
TREATED
POLES
IN this common, everyday scene is a story of safe, dependable service. Thousands of these AmCreCo full pressure treated pine poles carry tremendous loadings—day after day—fair weather or foul. They maintain an ample safety factor to the end of their long lives.
Careful timber selection, proper handling and treatment, and more than 30 years of experience have built the fine reputation of AmCreCo quality. Remember these facts when you require poles.
AMERICAN CREOSOTING COMPANY
INCORPORATED
COLONIAL CREOSOTING COMPANY INCORPORATED
AMCRECO LOWRY PROCESS CREOSOTED WOOD
GEORGIA CREOSOTING COMPANY INCORPORATED
ADDRESS INQUIRIES TO CHICAGO, ILL., OR LOUISVILLE, KY.

New EQUIPMENT AVAILABLE

Arc Welder

Low open-circuit voltage and a relatively high voltage for maintaining the arc are said to be secured in this new transformer-type arc welder through the use of a new



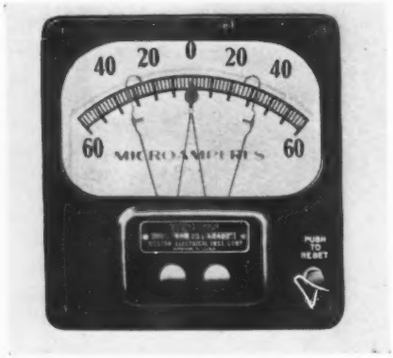
"Trans-Arc;" in 150-, 300- and 500-amp. sizes for operation on either 230- or 460-volt, 60-cycle circuits. **American Transformer Co.**, Newark, N. J.

circuit which utilizes condensers in combination with a welding transformer. Welding current is controlled by means of a continuously variable auto-transformer known as the "Transtat," which varies voltage across condensers.

•

Contact-Making Instruments

A complete line of contact-making instruments has been announced for use where control or limit indication of electrical circuits is desired without affecting accuracy of indicating instrument. Models are available with magnetic or non-magnetic contacts; manual resetting is required and provided for the indicator with magnetic contacts. Indicators with non-magnetic contacts use no manual reset, but require a special or auxiliary relay because of the vibration encountered in a.c. movements and the low torque available in d.c. movements.



Model 837 contact-making d.c. microammeter, with magnetic contacts; model can carry 5 watts at 110 volts a.c.; Model 838, non-magnetic contacts, can carry 5 amp. at 110 volts a.c. non-inductive load. **Weston Electrical Instrument Co.**, Newark, N. J.

•

Combustible Gas Indicator

New indicator for measuring directly the combustibility and explodability of gas-air mixtures in manholes, conduit systems and other places where flammable gas-air mixtures may be found is smaller and lighter than previous models. A sampling hose is dropped into the inclosure being tested and a sample of the gas-air mixture drawn up by means of a small suction pump. Meter shows directly the percentage of the lower explosive limit of the mixture being sampled. Pushbutton changes meter reading to volts for checking purposes. Current is supplied by two standard dry batteries.

Combustible gas indicator; weight 6 lb.; dimensions, 6¾ x 5¾ x 3¾ in. deep. **Davis Emergency Equipment Co.**, New York, N. Y.

•

Connectors

"Sub-Clamp-Tites;" for various tubing to tubing, tubing to cable, cable to cable and cable to tubing connections. **James R. Kearney Corp.**, St. Louis, Mo.

A variety of styles and types of connectors for substation construction are available in this new line. These clamp-type connectors are made of copper alloy for maximum electrical conductivity and are secured with Duronze carriage bolts and nuts for mechanical strength and permanent connection.

Current Transformers

New indoor and outdoor current transformers have been announced by this company. Outdoor type is said to be as

Outdoor instrument current transformers, old and new; in 23 to 161-kv. range, with oil or Pyranol. Indoor, 5,000-volt instrument current transformers not shown, Type JW-1, replacing WF-12. **General Electric Co.**, Schenectady, N. Y.

dependable and as accurate as the older style it replaces, yet is only one-half its size and weight. Greater accuracy, higher insulating qualities and finer construction are features claimed for the new 5,000-volt indoor current transformers. Use of a newly developed high-permeability steel and the patented Wilson scheme of compensation combined with close manufacturing control and narrower test limits are said to make for greater uniformity in these latter transformers.

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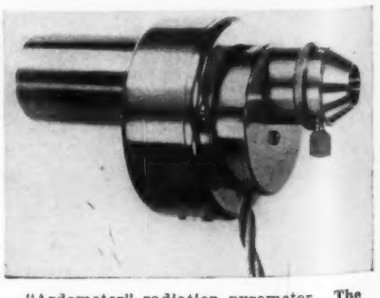
Radiation Pyrometer

New radiation pyrometer uses the "Ardometer" (illustrated) as a temperature-sensitive unit. Instrument measures



"Ardometer" radiation pyrometer. **The Bristol Co.**, Waterbury, Conn.

surface temperature of hot objects or masses above 1,000 deg. F., when the "Ardometer" unit is sighted directly on the object in the furnace so that it picks up the heat rays emitted. Unit is said to follow with fidelity the temperature changes of the object on which it is sighted.

•

Portable Potentiometer

New portable potentiometer has been built and designed especially for field or laboratory service. When used with thermocouples, unit becomes a checking

Portable potentiometer; three models, each with cold junction compensator, one with run-up box added, one with run-up box and thermocouple line compensating thermostat. **Wheelco Instruments Co.**, Chicago, Ill.

instrument; standardized with regulation standard cell, it is equipped with precision slide wires and multipliers. Galvanometer is of the dual taut suspension type. Scales may be obtained calibrated in millivolts or in degrees Fahrenheit or Centrigrade or both.

•

Welding Table

Pleased with the labor-saving features of a revolving welding table devised for its own use, this company is now marketing that table. The table has eight lines of radial slots for bolting work to it and is tilted by a hand-operated, self-locking worm and wheel to a vertical position either side of the center line. Table is driven by a ¼-hp. electric motor driving through a variable-speed transmission and worm gear reducer, speed being adjusted by means of a handwheel. Table speeds correspond to welding speeds of 0.43 to 2.6 ft. per minute, on a 30 in. diameter.

Revolving welding table; 31 in. in diameter and 25 in. high when horizontal; will carry a load of 600 lb. in tilted position. Welding Division, **Ransome Concrete Machinery Co.**, Dunellen, N. J.

Rheostat Tandem Assembly

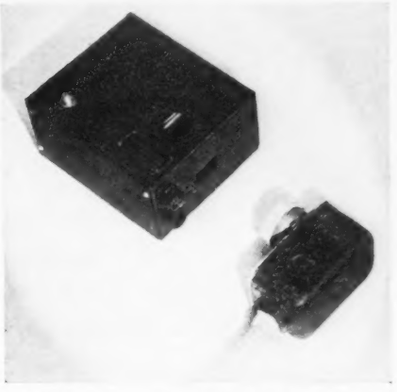
Rheostat tandem assembly; four 1,000-watt rheostats shown; intended for motor drive, each rheostat individually driven from shaft. **Ohmite Mfg. Co.**, Chicago, Ill.

For use with its larger-size rheostats, this company has designed a new type of tandem construction and assembly. Like the standard assemblies, this one is used for control of electrical apparatus where several circuits are to be varied simultaneously, as in the control of the individual phases of a three-phase line, etc. This special construction and assembly is offered for two, three, four or more rheostats in tandem, using any combination of the company's 300, 500 or 1,000-watt units.

•

Photoelectric Control

New photoelectric relay is offered as a rugged and inexpensive general-purpose control suitable for many photoelectric applications. It requires a minimum of 3 ft.-candles on the photocell; impulses required are 1/20 of a second between each operation. Control uses a 6J5 amplifier tube in addition to the photocell. Light source included is a 32-cp. automobile type bulb and will operate control at a distance of 25 ft.; it is supplied with a 2-in. focal length lens. Light beam may enter two sides of the box. Life of the vacuum tubes is said to average about 3,500 hours, while photocell should operate approximately 10,000 hours.



Model No. 50 photoelectric relay; operates only on 110 volts, 60 cycles. Telephone type relay carries a load of 2 amp., 110 volts, 60 cycles, non-inductive. **United Electronic Industries**, 43-37 Rawson St., Long Island City, N. Y.

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Bakelite Outlet Boxes

"Parker" Bakelite outlet boxes and covers; sizes same as standard metal boxes and covers. **Union Insulating Co.**, 227 Broadway, New York, N. Y.

A new line of Bakelite outlet boxes and covers has been announced by this company; they have been designed especially for use with non-metallic sheathed and Type CNX cable wiring as well as for applications where corrosive fumes are present.

•

Thermionic Amplifier

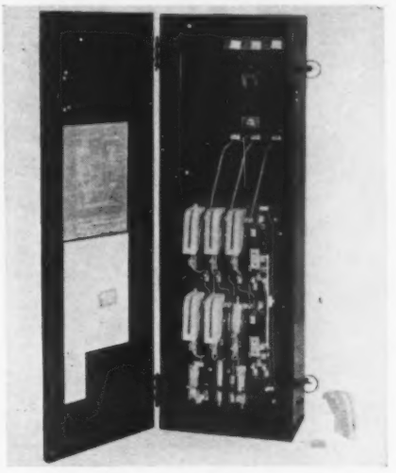
Thermionic amplifier. **Leeds & Northrup Co.**, Philadelphia, Pa.

Designed to bring high sensitivity to potential measurements in high-resistance circuits, this thermionic amplifier, drawing a negligible current, adapts potentiometer of suitable range to measurement of glass electrode potentials. Other uses include measurement of corrosion and oxidation-reduction potentials, of high resistances at voltages at which they are used. Readings are obtained through routine potentiometer measurements.

•

Reversing Switches

Low installation cost, space economy and increased safety are claimed features of a new line of combination reversing magnetic switches which employ air circuit breakers. Primarily intended for the



Combination magnetic a.c. reversing switch with air circuit breaker; max. rating, 25 hp. at 600 volts, three-pole; one arc chute and one relay heater removed. **General Electric Co.**, Schenectady, N. Y.

full-voltage starting of a.c. motors, the equipment is said to be particularly suitable for use where short-circuit protection for individual motors is desirable and as a means of disconnecting power-supply line to switch and motor. Complete device consists of air circuit breaker, two magnetic contactors magnetically interlocked and temperature overload relay, in an inclosing case designed to permit operation of breaker with the cover shut.

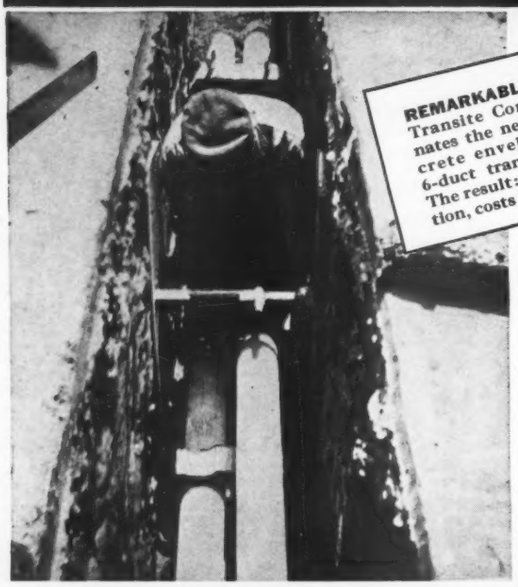
•

Industrial Reflector

Completing their line of "Lobay" reflectors in the 300- to 500-watt size, this company announces a new industrial reflector providing a 90-deg. spread of light. Concentrating, intensive or widespread light distribution from units similar in appearance is now available in this line; the prismatic reflectors which determine the light distribution are interchangeable in the same fixture part.

Widespread "Lobay" reflector No. 682, for 300- and 500-watt lamp. **Holophane Co.**, New York, N. Y.

EVERY TYPE OF DISTRIBUTION
can be handled at Low Cost with
J-M TRANSITE DUCTS



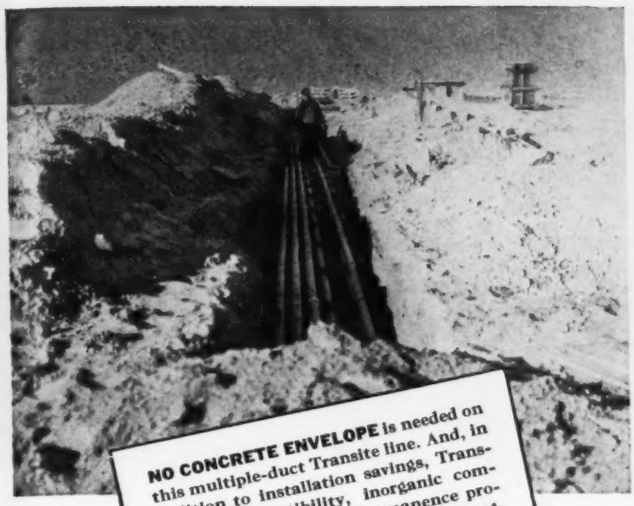
REMARKABLY STRONG, Transite Conduit eliminates the need for a concrete envelope on this 6-duct transmission line. The result: faster installation, costs sizably reduced.

Made of asbestos and cement, Transite Conduit and Korduct are incombustible, easily installed and remarkably resistant to corrosion

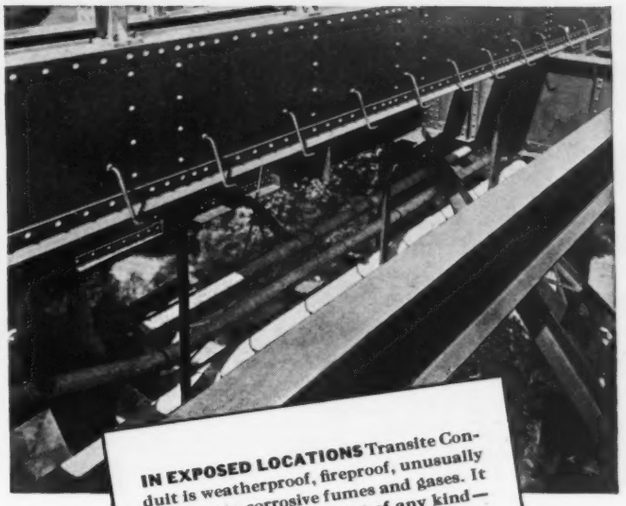
ABOVE GROUND or below ground... with or without a concrete envelope . . . J-M Transite Ducts are reducing installation and maintenance costs, and bringing greater permanence to electrical-distribution systems. These outstanding advantages are easily explained. J-M Transite Ducts are non-metallic, inorganic, made of a dense, tough composition of asbestos fiber and cement. They are incombustible, immune to electrolysis, exceptionally resistant to weather and corrosion. A permanently smooth bore permits

INSTALLATION SAVINGS, because of no "concreting-in," are even more important on single-duct distribution systems. In such cases, cost per duct-foot is cut to the bone.

PERMANENCE is assured because of Transite's inorganic composition. Made of asbestos and cement, it is unusually corrosion resistant. (The job shown below is another on which no concrete casing was required.)



NO CONCRETE ENVELOPE is needed on this multiple-duct Transite line. And, in addition to installation savings, Transite's incombustibility, inorganic composition and inherent permanence provide the maximum assurance of long, dependable service.



IN EXPOSED LOCATIONS Transite Conduit is weatherproof, fireproof, unusually resistant to corrosive fumes and gases. It needs no protective casing of any kind—will not rot or decay under any conditions.

long cable pulls with minimum effort, and without injury to sheathing.

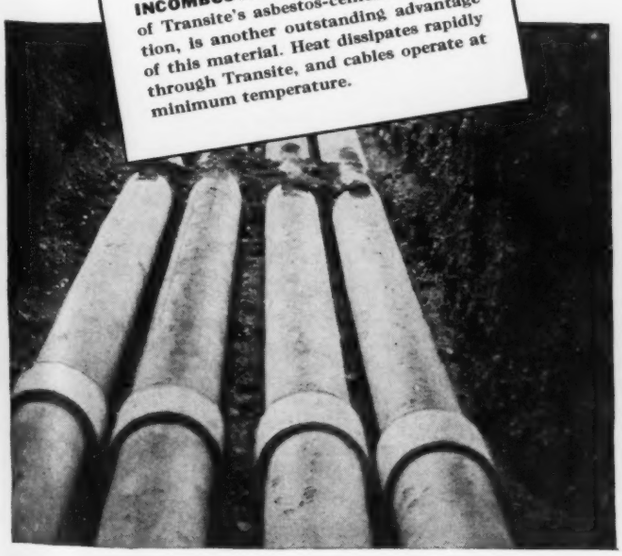
Extra strength and resistance to corrosion make it possible to lay Transite Conduit *without a concrete envelope,* bringing substantial savings at installation. Where "concreting-in" is specified, the thinner walled Transite Korduct gives every advantage of Transite Conduit and saves on material expense.

These two J-M Ducts have made hundreds of distribution systems less expensive to install and maintain. Complete information is contained in Data-Sheet Manual DS-410. For your copy, write Johns-Manville, 22 E. 40th Street, New York City.

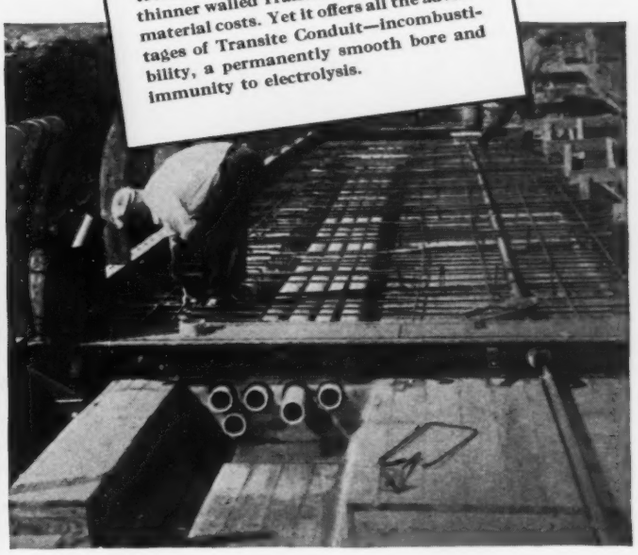
JOHNS-MANVILLE JM PRODUCTS

Johns-Manville
TRANSITE CONDUIT
for use underground without concrete envelope and for exposed locations
TRANSITE KORDUCT
for installation in concrete

INCOMBUSTIBILITY, again the result of Transite's asbestos-cement composition, is another outstanding advantage of this material. Heat dissipates rapidly through Transite, and cables operate at minimum temperature.



WHERE CONCRETE is specified, the thinner walled Transite Korduct saves on material costs. Yet it offers all the advantages of Transite Conduit—incombustibility, a permanently smooth bore and immunity to electrolysis.



Manufacturing AND MARKETS

Orders Drop Shown by General Electric

Orders received by General Electric Company in the first quarter this year totaled $65,376,400, as against $105,747,030 in the same period last year, a decrease of 38 per cent, according to Gerard Swope, president.

A dividend of 30 cents a share for the first quarter will be payable April 25 to 204,980 stockholders, a record high number, compared with 40 cents a share paid to 193,364 stockholders in April last year.

Bookings of Westinghouse Electric & Manufacturing Company for the first three months this year totaled $37,998,569, as against $74,242,584 in the same period last year, A. W. Robertson, chairman, reported last week at the annual meeting of stockholders.

Although bookings for the quarter were 49 per cent less than the same 1937 period, Mr. Robertson said that March business showed an increase of nearly $4,000,000 over February. March bookings were $15,126,588, against $11,439,127 in February.

"I believe that unless things get much worse than we are accustomed to expect in America," Mr. Robertson said, "we will come through without too much difficulty. There are substantial orders on the books. This month we will pay back $5,000,000 of the money we borrowed last year to help us meet the enormous rush of business and very soon we expect to pay off the balance, which will leave the company out of debt—the way we like to be. Orders were good in March, and so far in April the improvement continues."

On March 31 the company had unfilled orders of $53,651,814, as against $60,298,087 on January 1.

•

Will Make Small Motors

Owosso Parts Corporation, Owosso, Mich., recently organized with capital of $100,000, is arranging for the early establishment of a new local plant for the manufacture of fractional-horsepower motors and parts. Company has leased the former factory of the Walker Candy Company and will modernize and equip for large production, with initial facilities for employment of about 800 persons. Motor units will be designed particularly for use in automobile heaters and allied service. The new company is headed by Ralph Redmond, Flint, Mich.

•

Manufacturers Make Sales Assignments

Announcement has recently been made of the following sales assignments:

Westinghouse Lamp Division has appointed George B. Mackey manager southwestern district, with headquarters in St. Louis. Mr. Mackey has been associated with the Westinghouse Lamp Company since 1922.

Edison General Electric Appliance Company has established Hotpoint factory branches at Chattanooga, Tenn.; Dallas, Tex.; Syracuse, N. Y., and Minneapolis, Minn. H. C. Chestnutt will be in charge of the Chattanooga branch, D. H. Darnold the Dallas branch, L. E. Smith the Syracuse branch and Fred T. Egger the Minnesota branch. The branches will function as wholesale distributors, operating as independent units.

Corning Glass Works has appointed H. C. Biglin, Atlanta, Ga., representative in the eastern part of Louisiana, the state of Mississippi and the western part of Florida.

Maydwell & Hartzell, San Francisco manufacturers' representatives, have been named to represent Sauter time switches in the states of Washington, Oregon, Idaho and Montana. The company has been representing Sauter in San Francisco for a number of years.

Universal Cooler Corporation, Detroit, Mich., has appointed L. H. D. Baker head of its manufacturers' equipment sales division of the domestic sales department.

Nash-Kelvinator Corporation, Leonard Division, announces the appointment of the Roycraft Company, Minneapolis, as a Leonard refrigerator distributor. The new distributor's Leonard territory embraces eastern Minnesota and northwestern Wisconsin. Motor Parts Company, Philadelphia, has been appointed Leonard refrigerator distributor in southeastern Pennsylvania and southern New Jersey.

Sees Major Industry in Air Conditioning

In discussing the diversity of St. Louis industries recently before the St. Louisans, Inc., Roscoe C. Hobbs, president of that organization and of Hobbs-Western Company, dealing in railroad ties and wood products, cited the air-conditioning industry as one which might be made a major St. Louis activity. The St. Louisans, Inc., has recently been organized to promote the city's industrial growth.

"Air conditioning—the new industry which some economists have said alone could usher in good times—is a prospective major industry in St. Louis," Mr. Hobbs said. "Already we have more hotel rooms air conditioned than any other city, as well as the longest underground pipe-line air-conditioning system in the country. . . As the largest metropolitan center within easy reach of the vast air-conditioning market in the southern part of the Mississippi Valley and the Southwest, St. Louis has a natural expectancy for the growth of the air conditioning industry here."

•

Turbo-Generator Contract

Allis-Chalmers Manufacturing Company has been awarded contract by City Council, Grand Island, Neb., for a 5,000-kva. turbo-generator unit and condenser at a price of $143,098, for installation in municipal electric power plant, where expansion and improvements will be carried out.

•

Johns-Manville to Build Insulating Products Plant

Johns-Manville Corporation has announced that it has "decided to go ahead" with construction of a new $1,000,000 insulating board plant at Jarratt, Va., after deferring the project for some time because of uncertain business conditions.

Construction plans had been in abeyance since last year. Lewis H. Brown,

president, explained funds for the project were obtained in 1937 through issuance of new common stock, but that mounting uncertainties on the business horizon delayed the decision. He added the new factory would employ from 300 to 400 hands when in full operation. Initial operations are expected early in 1939.

•

Australian Boards Seek Bids on Power Equipment

Government Railways Department, Melbourne, Victoria, Australia, will receive bids until May 16 for a quantity of totally inclosed metal-clad switchgear.

State Contracts Control Board, Sydney, New South Wales, will receive bids until May 10 for a quantity of electrical engineering equipment, as per specifications on file.

Sydney County Council, Sydney, will receive bids until May 18 for a quantity of supervisory control equipment, as per specifications on file.

•

Construction Contracts Up 91 Per Cent During March

Construction contracts in the 37 Eastern states rose 91 per cent during March as compared with the preceding month, according to the report issued by F. W. Dodge Corporation. The total of contracts awarded during the month amounted to $226,918,000 for all classes of construction. This amount compares with $118,945,000 for February and $231,246,000 for March of last year. The gains reflected in the March construction volume were distributed among all the major classes of building. Public works and utilities, with a total of $59,699,000, was 96 per cent above the total for the preceding month.

•

Lamp Company Buys New Site

Announcement has been made that the Mutual Sunset Lamp Manufacturing Corporation, Inc., Brooklyn, has purchased seven acres of land with railroad facilities in New Brunswick, N. J., and will erect a one-story building there with about 60,000 sq.ft. of floor space.

New York Metal Prices

	April 13, 1938 Cents per Pound	April 19, 1938 Cents per Pound
Copper electrolytic	10.00*	10.00*
Lead Am. S. & R. price	4.50	4.50
Antimony	13.75	13.75
Nickel ingot	35.00	35.00
Zinc spot	4.40	4.55
Tin straits	38.50	39.875
Aluminum, 99 per cent.	20.00	20.00

*Delivered Connecticut Valley.

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Taylor "Planned Service" is geared to meet requirements, large or small, standard or special . . . can be relied on, always, as an unfailing source of supply . . . permitting *you* to operate with smaller inventories. Ask for more information.

TAYLOR FIBRE COMPANY
NORRISTOWN, PA.

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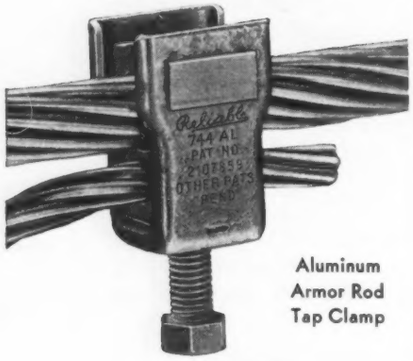
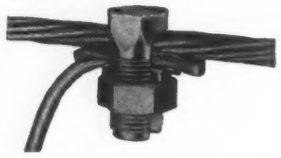
FOR

RED OR WHITE CONDUCTORS



Aluminum Armor Rod Tap Clamp

Aluminum to Copper Connector



Type A Copperweld Straightline Splice

Splicing Sleeve

Copper Wire Solderless Connector

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ELECTRIC COMPANY
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Field Reports on Business

The electrical business is showing more encouraging signs, with manufacturers reporting some improvement over earlier weeks this year. Utility buying continues slow, with heavy construction held to minimum requirements pending an expansion in industrial activity. A better feeling exists.

NEW YORK

Easter season business in this district was very gratifying. The new spending program of the Administration is expected to help business, at least while the money lasts. Sentiment among business leaders is more optimistic than in many months and is being reflected in a slight increase in the number of orders placed.

Electrical business in March showed improvement over the two preceding months and has carried over into April. Electric utilities find that some power load is coming back on the lines. The commercial and residential loads have held up well, showing slight increases over a year ago.

Appliance sales have been moving relatively slow. The range show in Buffalo was a success, with 100 ranges sold during the week and several hundred live prospects obtained.

Once the industrial power use curve definitely turns upward additional capacity is expected to be installed by the utilities. At present several major installations are being held up pending better conditions. While construction budgets are now being held to a minimum, several utilities declare that they could be quickly expanded to meet demands.

NEW ENGLAND

A marked improvement in electrical equipment sales is reported in this district. One of the largest single motors purchased in this district during the past few years was recently sold by the Westinghouse company to the Massachusetts Institute of Technology. Rated at 2,000 hp., this motor will be installed in a new wind tunnel for aeronautical research.

Utility buying during the past fortnight was quite active; a Connecticut utility bought a power transformer amounting to about $25,000 and an eastern Massachusetts utility has added another power transformer involving about $20,000. Negotiations are decidedly more active in the central station apparatus division, according to one prominent manufacturer.

Industrial electrical supplies are showing a more encouraging trend. Motor sales are steady, though not as yet materially above the first quarter level. Recently an ice manufacturing and cold storage plant now being erected bought four 50-kw. generators.

Interest in combination mercury-vapor incandescent lamp units is very active. One manufacturer reports negotiations have been closed for a number of industrial and institutional installations. Air conditioning is progressing—the Warren Telechron Company has recently installed a General Electric 9,600-c.f.m. air-conditioning system for its motor assembly department. A manufacturer of electric meters reports that 150 prepayment type watt-hour meters were purchased by a number of utilities during the past week as a hedge against delinquency in residence bill settlements. Merchandising is reported to show a marked upward trend in this area.

An increase in small institutional type buildings which are proposed for new construction is notable in this district and presages a very encouraging amount of wiring supplies for this coming summer. A new library will be built at Babson Institute, Wellesley Hill, Mass.; modernization has been planned for Jordan Hall, Boston.

CHICAGO

Business activity is indicated currently to be near the low point of the depression. Further lag in the heavy industries appears to be the principal factor, although retail and wholesale trade has been exceptionally disappointing. Even with the stimulation provided by Easter buying, activity did not reach expectations.

Electrical manufacturers report business to be very slow. Equipment sales are running from 30 to 70 per cent below this time a year ago. After maintaining a fairly steady level for three or four weeks, orders began to decline again during the past week. Of the 42 manufacturers reporting to the Electric Association, 87 per cent show a decrease in sales from a year ago. Eighty-six per cent of the wholesalers also report a decrease.

Dealers are aggressively promoting electric ranges through demonstrations and advertising. Resulting sales show that public acceptance is much greater than it was five or six months ago. Sales show steady improvement, with a number of dealers doing a satisfactory business. Street and highway construction has resulted in some good orders for street and traffic lights.

PACIFIC COAST

Wholesalers and contractors report many quotations and bids with a reasonably quick conversion into orders. April business is being placed rather conservatively, but with no apparent disposition to withhold it indefinitely, and especially encouraging is its industrial proportion. Recent orders from industrials include such varied material and destinations as 60-hp. motors and control equipment for a northern California dredging company; 250 pressure system ½-hp. motors, value $7,000, for a pump manufacturer; two a.c. welders, value $2,500; several 200-hp. motors for an oil company, and 75 exposure meters for a motion-picture equipment concern. The Hawaiian Islands are represented by plantation equipment totaling $20,000 and including lightning arresters, switchboards and a 500-kva. generator.

Prospective industrial construction includes the million-dollar General Electric building in San Francisco, an oil-treating plant at Wilmington, a packing plant at Santa Barbara and additions eventually totaling $1,000,000 to the Federated Metals San Francisco plant.

Steel firms have been busy on orders, such as 1,500,000 penstock plates for Grand Coulee Dam. The first quarter of 1938 showed a 10 per cent personnel decrease and a 3 per cent earning increase for manufacturing establishments in the Bay area. Refrigerators and other major appliances are considerably below their seasonal volume.

Westinghouse Workers Paid $468,451 in Sick Benefits

Despite an increase of 7,000 employees during the year, the accident rate in the eighteen plants of the Westinghous Electric & Manufacturing Company increased only two-tenths of 1 per cent in 1937, according to Dr. T. Lyle Hazlett, medical director. First-aid treatment for cuts and scratches was credited for having eliminated serious infections resulting from shop work during the year.

A special study, including periodic examination of 100 electric welders, presented no evidence of health impairment resulting from this type of work, Dr. Hazlett said, explaining that, "it is believed there is almost no danger from welding provided ventilation is adequate." During the year 3,070 members of the voluntary relief department received $468,451 in sick benefits, an average of $152.59 per patient.

•

Exports 24% Over 1936

Electrical exports during 1937 were 24 per cent higher in value than in the preceding year, rising to $122,746,477, compared with $98,982,636 in 1936. Outstanding items follow:

Item	1937	1936	Inc %
Radio apparatus	$32,102,070	$28,278,705	13.5
Electric refrigerators and parts	20,672,846	19,171,400	7.8
Electric household washing machines and parts	2,242,279	1,116,433	100.8
Electric domestic vacuum cleaners and parts	876,840	806,838	8.7

The figures are from the Electrical and Radio World Trade Notes, issued by the Department of Commerce.

•

Suggestions Net $85,000

General Electric Company employees during 1937 received nearly $85,000 for new ideas submitted through the company's suggestion system. During the year almost 37,000 suggestions were made by workers, and more than 12,000 were adopted. During the past eleven years nearly $600,000 has been paid out to employees for new ideas adopted for use.

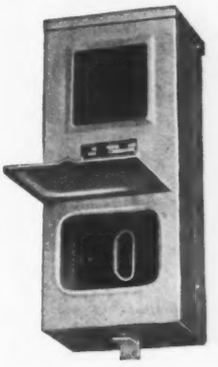
•

Protest AFL Activities

Protesting against the activities of AFL electrical workers' representatives in trying to organize men employed on the REA project at St. John, Wash., farmers in that district have formed an association known as the Associated Farmers of Whitman County, for the express purpose, it was stated of halting the practice.

In BOTH Corners

CHAMPIONS



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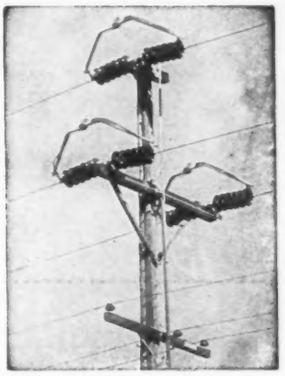

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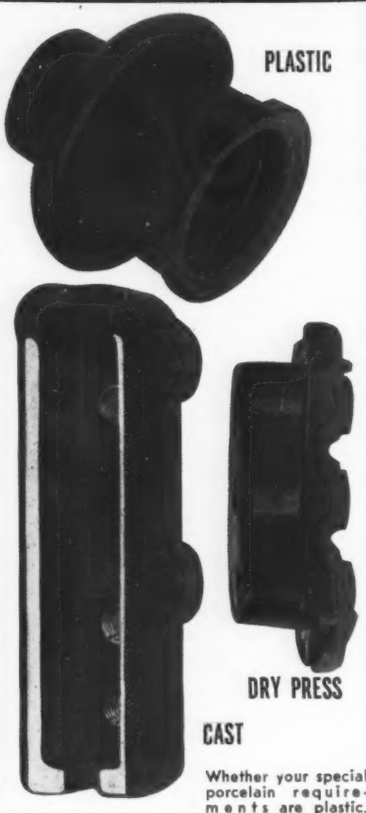

Whether your special porcelain requirements are plastic, cast, or dry press porcelain you can get all three from this one source where experience and modern facilities insure the utmost in dependability.

The Illinois organization has produced special porcelain insulators for electrical equipment for almost a quarter of a century. The constant growth of this service to electrical equipment manufacturers has undoubtedly been due to the close attention given this type of work in our plant. Specify Illinois! Send for samples.

ILLINOIS ELECTRIC PORCELAIN CO.
MACOMB, ILL.

The Distribution Engineer and Utility Management

[*Continued from page* 58]

load tests are misleading unless these tests are made over a sufficiently long period of time to determine definitely the load factor of the group of customers supplied. However, in both transformer loading as well as cable loading the thermal factor should be taken into consideration. A peculiar load or a peculiar location of a transformer may limit its loading. Under normal conditions of service, however, the average distribution transformer supplying a mixed commercial or residential load is selected more from the standpoint of judgment than from the standpoint of its rating. In other words, the connected load may be many times the transformer's rated capacity.

Likewise, full advantage may be taken of cable loading if the cable temperature is known prior to the time of peak load that parallel circuits may be provided for or added ventilation or cooling provided for the cable in question. In other words, if the characteristics of a cable circuit are known, it is possible to realize even an increase in capacity when each cable loading and ventilation may be controlled separately.

Management highly dependent on competency of distribution engineer

While it may be both practical and economical to select a No. 2 secondary main for the most economical loading for from 25 to 100 kva. per thousand feet of line, the economy in the loading of this copper certainly does not vary directly with the extreme loads that may be imposed upon it. However, the smart distribution engineer usually will avoid being caught with secondary mains too small. The cost of changing them is great, and a better plan is to balance the value of the copper in place with the kilowatt-hours lost capitalized at system cost against the value of a moderate size transformer with its inherent losses capitalized, taking into consideration, of course, the junk value in each case as a credit. In most cases the balance is in favor of copper.

The present situation, as drastic and as objectionable and as disturbing as it is to many of us, has placed the distribution engineer in a position that he is absolutely drawn closer to the executives of his company than ever before. They are, in fact, more dependent on his judgment, on his ability and on his execution, in my opinion, than at any time in the history of our business. The successful engineer, however, to meet the new requirements and to be of practical value to his executive, his company and himself, must be able to develop more fully a characteristic that seems to be lacking in the make-up of many good engineers, and that is commercial adaptability.

Certainly the time is now here when a broader and brighter opportunity surrounds the distribution engineer than at any time during my experience in utility work. Executives are looking for producers. By selecting a distribution engineer having the qualifications I have tried to outline above, and by giving him the necessary co-operation in carrying out the functions as modestly outlined, the executive of a utility may be sure that, as far as the distribution system is concerned, he will be able to render adequate service economically, which, in turn, will result in profit to the stockholders and insure him of a satisfied public.

•

G. E. to Furnish New Units

Northern Paper Mills, Green Bay, Wis., have awarded contract to the General Electric Company for turbo-generator units for new steam-electric generating station at local mill, estimated to cost approximately $750,000. An award for high-pressure boilers and accessories has been made to the Riley Stoker Corporation, Worcester, Mass. Orders for miscellaneous equipment are scheduled to be placed soon, as well as award for building erection. Sargent & Lundy, Inc., Chicago, Ill., is consulting engineer.

•

Safety Code to Be Revised

Early revision of the safety code governing construction and operation of electric power lines was seen as a possibility in Michigan following the recent appointment of a committee of sixteen experts to study the proposed changes. Action on the revision will be taken by the state Public Utilities Commission on recommendation of the committee.

Lighting Fixture Guild Formulates Promotion Plan

Lack of outlets for electric lighting fixtures in new homes obviously is a barrier to the sale of lighting fixtures, declared Julius Daniels, Boston Edison Company, at a recent meeting of the local members of the National Lighting Fixture Guild in that city. Mr. Daniels declared that if the lighting fixture industry would present a united front on this important matter the omission of needed lighting fixtures could be avoided in the great home-building activity that is planned.

Another speaker, Charles Michalson of New York, emphasized the indispensability of active local guild groups to carry on educational programs with local architects, decorators, contractors, builders and the general public.

•

York to Release New Film

"Cold Magic," a sound motion picture of air conditioning and refrigeration, will be released in the near future by the York Ice Machinery Corporation. This thirty-minute film describes the processes and craftsmanship employed in the manufacture of mechanical cooling equipment. It will be distributed throughout the York organization, for all its employees to see, and for all York distributors and branch offices—domestic and foreign—to show to civic and business organizations, technical schools and national professional groups. "Cold Magic" was filmed by Castle Films, Inc., New York.

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Export Licenses Continue

So far as the Canadian government authorities are aware there will be no interruption in export of electricity to the United States under the present licenses, which have been in force for a number of years, subject to annual renewal. It was generally assumed that our government's veto of the proposed import of Canadian power into the United States referred only to new importation such as would be involved in Ontario's proposal to export newly acquired surplus power to New York.

•

TVA Leases Reservoir Land

Gulf Refining Company has leased approximately 10 acres of land near Guntersville, Ala., from the Tennessee Valley Authority, John B. Blandford, Jr., general manager of the Authority, has announced. Approval of the lease has been made by the TVA board of directors. This is the first lease of TVA reservoir lands for industrial purposes granted by the board.

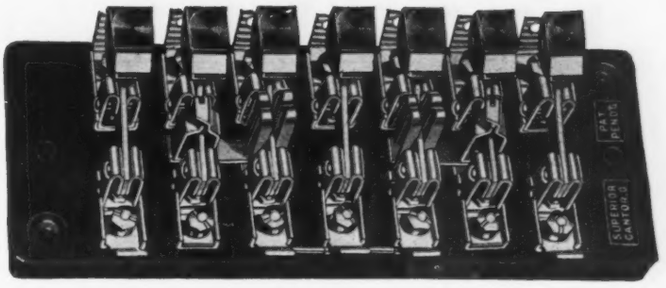
TEST SWITCHES

FOR

TESTING
CALIBRATING
DISCONNECTING

—

METERS
RELAYS
INSTRUMENTS



Superior Test Switches are rugged and safe. Using the famous Superior "One-piece-jaw" construction they add a minimum number of joints to the circuit. They come in a variety of arrangements to meet your test switch needs.

Write for Test Switch Bulletin No. 3401

Superior Switchboard & Devices Company

CANTON, OHIO

*Been at it Since 1920

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Instruments Register Strains in Bonneville Dam Concrete

[*Continued from page 60*]

so that it could also be used to measure temperature.

Nine such foundation meters were placed under one block so as to measure the varying foundation deformations from the upstream edge to the downstream edge of the dam.

Few difficulties and simple corrections

Few difficulties were encountered in obtaining temperatures from the termometers since they are relatively simple devices. Small changes in readings were noted when the lead length was changed, due to inequalities of resistance of the added leads. In one test the maximum resistance variation was found to be about 4 per cent in supposedly uniform No. 14 solid copper wire. This type of error was corrected by taking readings immediately before and after making any change in lead length and assuming that the temperature remained constant during the fifteen or twenty minutes required for splicing.

The problem was encountered frequently because the instruments were read at first where the leads left the concrete; that is, at the top of a pour or at the walls of the inspection gallery, and then, after splicing, at the terminal panel location then in use. The terminal panels were moved five times to keep pace with construction, the fifth and final location being near the access shaft to the inspection galleries in the control house on Bradford Island.

A change in the length of leads from the strain or stress-measuring devices directly affected the readings in two ways: First, since the initial unstrained ratio of these instruments was unity only by accident or coincidence, equal resistances added to each coil changed the ratio, making it more nearly unity. Also, as previously indicated, the added resistances were not always equal. In each case, therefore, it was necessary to select a new value of ratio to indicate zero strain or stress. Second, with more resistance in the circuit a given change in coil resistance became a smaller percentage of the whole, and the calibration constant (strain per unit change of ratio) became larger. Within the limits of accuracy obtainable the new calibration constant was found to be equal to the original constant multiplied by the ratio of the new resistance to the original resistance, both resistances being measured with the instrument coils in series.

Stray currents occasionally caused the galvanometer needle to swing erratically and made it difficult to read some instruments. Various possible causes for this trouble were considered, the most probable being that welding ground currents were in some way getting into the circuit through leaky insulation at the instrument or at splices in the concrete. The assumption was made because of the regular swings of the galvanometer needle and because practically all the trouble stopped when the welders were not working. Little difficulty was experienced after the welding was finished on those blocks which contained embedded instruments.

Corrections for thermal changes are made in the case of strainmeters because the meter parts expand more than the surrounding concrete for a given temperature rise. If no correction were made the readings would be considerably in error; for example, when the temperature increased a compression would be indicated even though no actual strain existed.

Foundation-meter readings are also corrected for temperature change because of the long pipe attached to the meter. Curves of temperature against depth are plotted and the pipe expansion computed. Since the temperature variation is not a simple function of depth the calculations are more involved than those for strainmeter corrections, and as the gage lengths are greater the relative magnitude of the corrections is also greater.

Early results

Of the early results from the installation, only temperature data are at all complete. The thermometers showed an average rise of about 40 deg. F. three days after pouring, and from that point the temperature decreased steadily unless affected by the heat from a succeeding lift. Approximately eighteen months after pouring the maximum temperature in the south half of the spillway dam was 66 deg. F., bedrock temperature at that time being about

53 deg. F. The highest recorded temperature was 126 deg. F., the thermometer being about 25 ft. below the finished surface of the block.

The strain and stress-measuring instruments have operated satisfactorily, only nine failures having occurred to date out of 287 instruments originally installed. Foundation compressions up to 0.1 in. over the 30-ft. gage lengths are indicated, although the total deformation as well as the total stress in various portions of the structure will not be known until the gates are closed and the dam is in operation.

•

Reports Substation Rating Is Twice Generator Rating

Two kilovolt-amperes of substation capacity are needed for each kilovolt-ampere of generating equipment, according to the experience of one large utility company, as shown in the following data from the annual report of Columbia Gas & Electric Company:

	1937	1936
Generator capacity (kva.)	515,578	482,628
Substations (number)	115	118
Substation capacity (kva.)	1,042,738	902,355

Corresponding ratios and averages are:

Substation kva./generator kva	2.03	1.87
Average kva. per substation	9,050	7,650

•

Acquires First Land Tract

Oklahoma's $20,000,000 power and flood control project on the Grand River in eastern Oklahoma acquired its first tract of real estate when the Grand River Dam Authority board authorized acceptance of a deed from the Grand Hydro-Electric Company for approximately 55 acres of land near the dam site. The pressing problem before the authority at present is the early completion of a preliminary appraisal of all lands to be purchased for submission to PWA officials. This step is necessary to assure PWA authorities that the amount of $1,250,000 set aside for land purchases will be ample for that phase of the project.

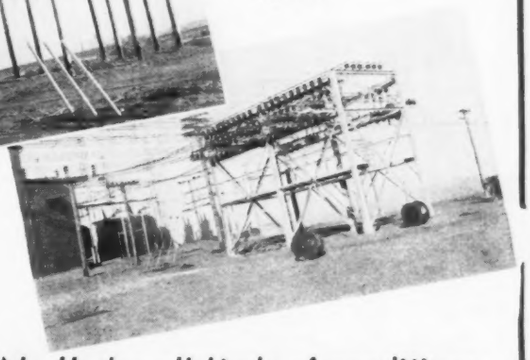
•

Vacuum Cleaners as Prizes

At least 1,200 housewives will have new Westinghouse vacuum cleaners this spring when Crisco concludes its current series of six weekly nation-wide contests on May 1. A first prize of $1,000 in cash and 200 vacuum cleaners will be awarded as prizes each week.

• *Wood Pole Structure for 6600 v distribution system forming a turn of ninety degrees.*

• *Steel Switching Tower erected at Fort Peck, Montana.*



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SPECIFIED BECAUSE OF PROVED PERFORMANCE

Crapo Galvanized Steel Strand has earned its enviable reputation for long, dependable, economical life by outstanding performances in actual service. That's why it so often is specified by leading utilities for the more important construction jobs. The heavy, uniform, pure zinc coating—applied by the *Crapo* Process—is notable for its adhesion and ductility; its ability to withstand bending and twisting; its lasting resistance to corrosion. Both the finished strand, and the wire from which it is made, conform in every detail to the most rigid specifications for tensile strength, elongation, size, galvanizing and ductility.

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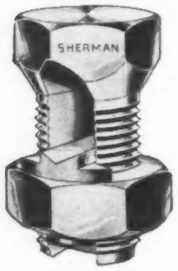

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For primary, secondary service, and transformer solderless line taps. Bolt, spacer, and nut an integral assembly. Strong.

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Get samples and Trade Bulletin No. 22.

H. B. SHERMAN MFG. CO.
BATTLE CREEK, MICH.

Series Capacitor Regulates Furnace Power Factor

[*Continued from page 63*]

tension side by the use of shunt capacitors, since the power factor on the high side determines the cost of power. This method has several disadvantages:

First, when the high-tension voltage is high the cost of a shunt capacitor becomes relatively expensive per kva.

If the reactive kva. required varies over a wide range during each run of the furnace, this would necessitate splitting the capacitor bank into a number of sections for automatic or manual operation, either of which materially increases the cost of the installation and substantially adds to the cost of operation.

The use of shunt capacitors, if properly switched, would maintain the power factor between reasonable limits on the high-tension side, but would not relieve the supply transformers from handling this large wattless component. Such transformers may therefore have a kva. rating more than twice the actual kw. load required.

The second method of attacking the problem is to use a series capacitor in the furnace circuit itself. Since the reactance of the circuit is fixed by the bus structure and is relatively constant, it can be compensated by a fixed amount of capacitance connected in series with the furnace. With this fixed condition the drop in the circuit is then determined by the resistance of the furnace and the buses in the circuit. Unity power factor is then obtained for any operating current employed and for any circuit voltage applied. The resultant power factor is relatively constant, since such variations in reactance due to tap changing of the transformer are negligible.

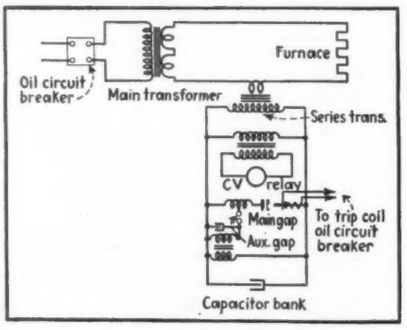

Fig. 3—Schematic diagram of series capacitor for resistor type furnace

Series capacitors applied to correct the power factor on the low-tension side of the furnace transformer. In order to obtain minimum first cost per kva. in an installation of this type it is necessary to operate the series capacitor at its full rating. This makes it necessary to predetermine the maximum continuous operating current, in order that the capacitors will be worked at their normal rating when carrying full load amperes. Since it is standard practice to allow a 15 per cent overvoltage limit on the continuous operating voltage of capacitors, and a double voltage momentary limit, it is possible to make use of this margin and obtain the additional corrective kva. over and above the nominal rating provided the additional kva. is supplied in the series transformer.

When the circuit reactance is compensated in this manner the kva. of the supply transformer is reduced from more than twice the actual load to very little more than the actual kw. full load required. Because of the low voltage across such a series capacitor, it is necessary to step up the voltage by means of a suitable series transformer. The primary of the series transformer is connected in series (Fig. 3) with the furnace, while the capacitors are connected across the secondary of the series transformer.

Protection can be provided against operation in excess of 115 per cent of rated voltage by means of a voltage relay arranged to trip the furnace breaker. This relay takes care of a condition of current in excess of the maximum for which the system is designed or the overvoltage which will occur at normal full load current if individual fuses on the capacitor units should fail.

Protection* is also provided for momentary overvoltage transients exceeding double voltage by the use of carbon gaps shunting the capacitor. These carbon gaps are caused to pass current, when the voltage across the capacitor doubles, by the use of an auxiliary gap circuit acting to ionize the gap. The current through this protective gap initiates the tripping of the furnace breaker.

Capacitor regulation automatic

Since the corrective kva. of the capacitor varies with the square of the voltage across it, the relation between the load current and the corrective effect is entirely automatic, increasing from zero at no load to the maximum value at full load without the necessity of any attention from the operator or any change in the circuit, or capacitor kva.

In addition to the advantages of the series capacitor in this application it can be proved considerably cheaper than a shunt capacitor, taking into account the saving in transformer kva. and the elimination of expensive switching means.

The use of a series capacitor in a furnace circuit of this type has further advantages that are lacking in other series capacitor installations,

* The details of the high-frequency controlled gap are given in *Electric Journal*, March, 1936, "Series Capacitors," by R. E. Marbury and W. H. Cuttino.

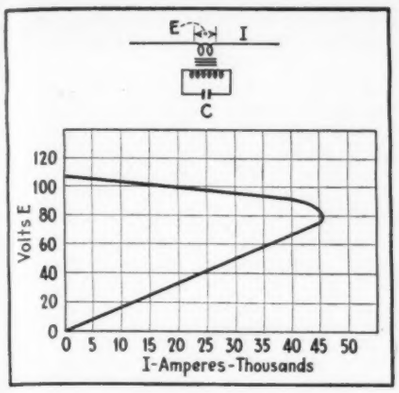

Fig. 4—Typical volt-ampere characteristic curve of transformer connected series capacitor

If an effort is made to raise the current by increasing the voltage from the supply transformer the current in the line reaches a maximum, and then begins to decrease, as the increasing saturation of the series transformer increases the effective capacitance ohms. The working range of the equipment is shown by the straight line and the maximum value of current indicated where the curve turns.

particularly those installed for regulating purposes in transmission lines:

First, the characteristics of the furnace circuit are known more definitely and they remain unchanged. This makes it possible to determine very closely the rating of a series capacitor which will be satisfactory for a given furnace and circuit. Secondly, in the case of the furnace application, the voltage across the primary of the series transformer is generally higher than the voltage supplied by the furnace transformer. As a result, if the furnace is short-circuited, the impedance of the transformer and capacitor combination inherently keeps the circuit stable and prevents any high value of short-circuit current. Any attempt to pass an excess of current disturbs the relative values of capacitance and reactance ohms and limits the current as a result.

The typical curve shown in Fig. 4 illustrates this self-limiting characteristic of this circuit including series transformer and capacitor.

•

Will Establish New Plant

Line Material Company, South Milwaukee, Wis., will establish a branch plant at Zanesville, Ohio, for the manufacture of electrical distributor transformers, in the former Butler & Pierce plant. Reconditioning of the plant started early this month.

•

Canadian Output Declines

Output of central stations in Canada during February totaled 2,057,604,000 kw.-hr., as compared with a revised total of 2,280,353,000 in January and 2,146,578,000 kw.-hr. in February a year ago. Exports to the United States in February were 123,095,000 kw.-hr., compared with 157,532,000 in January.

BUDA-HUBRON *Pole Hole Drills*
SAVE MONEY FOR YOU!

Low first cost—low operating cost.
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Buda-Hubron Earth Drill mounted on standard 1½ ton motor truck, used by The Buda Company as a demonstrator.

THE BUDA COMPANY, Harvey (CHICAGO SUBURB) Illinois

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The Greenlee Hydraulic Conduit and Pipe Bender is as easy to use as the picture above shows. It is made in two sizes for conduit from 1¼" to 3" and from 2½" to 4½". The small bender can be fitted with a set of attachments for bending thin-wall steel conduit in 1¼", 1½" and 2" sizes.

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Good workmen demand good tools. In the hands of men who know — everywhere — the pliers are invariably Kleins. Only the keen, hand-honed, perfectly matched cutting knives of Klein Pliers — only the comfortable spring grip in the Klein handles — only the general all around quality that is an inherent part of every Klein Plier can satisfy men whose work demands the best in tools. This, perhaps, explains why Klein Pliers are the standard of quality by which others are judged — why the name Klein has stood for maximum quality, "since 1857."

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The four pamphlets listed below will be sent without charge to anyone interested. Check the ones you want:

- ☐ Safety for the Pole Climber.
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Municipal Plants

PARAGOULD, ARK.—Approval of a $100,000 bond issue for a municipal light plant was voted on April 5. Voters upheld an ordinance providing for issuance of bonds to obtain a PWA loan and grant to build a city power plant. Citizens defeated 327 to 237 a proposed ordinance calling for a new vote on the bond issue which was authorized last year. A four-year fight has been waged over the project.

LA JUNTA, COLO.—Regardless of the fact that the Southern Colorado Power Company proposed to erect a plant in La Junta and not depend on long-distance transmission, as is done at present, city officials will ask voters in an election scheduled for May 10 to approve the erection of a municipally owned plant, costing $497,000. Bonds are to be issued. Election date was previously announced for April.

PLAINVILLE, KAN.—Voters at a recent election failed to record the two-thirds majority needed to carry the $100,000 bond issue for the proposed municipal light and power plant and distribution system. The final official count showed 303 votes for the bond issue and 270 against.

FULTON, KY.—City Council on April 4 adopted a resolution that the body take steps toward acquisition "by purchase" or "by construction, or both" of an electrical distribution system to be owned and operated by the city for the purpose of furnishing electric energy at low rates to its citizens. The Mayor was authorized and directed to communicate with TVA. Kentucky Utilities Company serves the city.

LA CENTER, MINN.—Voters recently defeated a municipal power plant proposal, 377 to 309 at a special election.

SANDUSKY, OHIO—City Commission has authorized City Manager Robert L. J. Wagar to confer in Washington with PWA officials regarding an advance of $45,000 on a loan and grant of $1,515,000 set aside for a proposed municipal light plant, so preliminary plans may be drawn and another bond issue submitted to a vote. A bond issue voted in 1933 was declared illegal by the Toledo Appeals Court because such plans had not been filed, and an attempt to amend the Sandusky city charter to make the approved bond issue legal failed at a recent election. The issue was believed dead until a PWA official informed City Manager Wagar that a loan might be arranged to have the complete plans drafted, as required by the city's charter. City Commission also passed a resolution to negotiate with the Ohio Public Service Company for the purchase of its Sandusky distribution system. It has no generating system, energy being sent in from Lorain and Toledo.

ETOWAH, TENN.—In an amendment to the original injunction bill filed several months ago in chancery by the Etowah Water & Light Company against George Bell et al., or the city of Etowah, the private power company charges 42 persons voted illegally during the city bond election last September. The injunction bill has been "lost" in chancery dockets, and although it has been tried, the answer has been withheld awaiting the amended clauses. The injunction amendment charges that "had disqualified voters been rejected as they should have been, the result of the election would have been against the issuance of bonds," and "that the town is trying to sell and issue bonds for acquisition of an electric light plant, solely upon the illegal referendum and vote on the bond issue."

LANCASTER, TEX.—An election held recently on the proposal of City Council to construct a municipal electric light and power plant resulted in defeat of the plan by a vote of 162 to 159. The city is now being served by the Texas Power & Light Company.

SUPERIOR, WIS.—Citizens on April 5 voted against purchase of the Superior Water, Light & Power Company at the state Public Service Commission's valuation of $4,625,000, by a 7,582 to 4,202 vote, and by a 7,646 to 2,511 vote went on record as favoring another referendum in case a new valuation is set.

PLAIN, WIS.—Citizens voted 142 to 26 in favor of selling the municipally owned electric utility to the Wisconsin Power & Light Company.

WHITEHALL, WIS.—By a vote of 324 to 91 citizens declared themselves in favor of purchasing the distribution system of the Northern States Power Company.

•

Recent Rate Changes

WORCESTER SUBURBAN ELECTRIC COMPANY has been ordered by the Massachusetts Department of Public Utilities to reduce its electric rates approximately $60,000 a year. All classes of customers benefit from the offer. The new schedule becomes effective May 1.

WISCONSIN POWER & LIGHT COMPANY has been ordered by the state Public Service Commission to reduce its rates to 32 wholesale customers. It is estimated that the reduction, to be made to 26 municipal electric plants and six privately owned utilities will total about $36,800 a year. In connection with the order, the commission closed its general rate investigation of the utility, started June 11, 1931, during the course of which it has reduced the company's electric and gas rates to save an estimated 107,000 customers in 300 communities and 15,000 sq.mi. of rural territory approximately $910,000 annually.

ILLINOIS COMMERCE COMMISSION has announced that during the month of March utility rates decreased approximately $63,690. Of this amount, $31,721 was applicable to electric utilities.

NEW JERSEY BOARD OF PUBLIC UTILITY COMMISSIONERS has announced that fourteen reductions in electric rates brought savings to users throughout the state of $2,129,032 during 1937. This was reported by the board in its annual statement to Governor Moore. The electric rate reductions represent a major portion of the total utility reductions which amounted to $2,631,073.

OHIO PUBLIC SERVICE COMPANY, which recently took over the properties of the Lake Erie Power & Light Company in Bellevue, has slashed electric light and power rates in Bellevue to amounts ranging from 16 to 34 per cent for resident users and from 24 to 40 per cent for commercial consumers. Bellevue City Council has recently passed legislation which would allow the city to purchase or condemn the company's distribution system, a counter-move in a four-year rate controversy with the Lake Erie Company. New residential rates range from 4½ to 2 cents a kilowatt-hour, depending on

consumption. New commercial rates range from 6 cents a kilowatt-hour for the first 30 kw.-hr. to 3½ cents a kilowatt-hour for all in excess of 60 kw.-hr. In a recent Federal Power Commission report Bellevue was classed as having the highest rate for electricity in Ohio in cities of the 5,000-10,000 class.

DECATUR, IND., municipal light plant's reduced rates have been approved by the Indiana Public Service Commission, bringing an estimated annual savings to patrons of approximately $15,000.

ENDICOTT (N. Y.) BOARD OF TRUSTEES has slashed electric rates 15 per cent, reducing by $12,000 a year the village income. It is estimated, however, that the municipally-owned plant will give a profit of about $15,000. The board ignored the request of the state Public Service Commission for a 75 cent minimum charge, setting this charge at $1.

JACKSONVILLE, FLA., household consumers have begun to receive cuts in their electric bills. The reduction, which affects every single consumer in the household rate schedule, will mean a total saving to this class of users of approximately $7,000 a month. City Utilities Commissioner Ernest E. Anders put through the rate cut at the top of the schedule, or from 7 to 6 cents for each of the first 35 kw.-hr., last December, to become effective with the March meter readings.

JONESBORO, ARK., municipal light and water plant has announced that effective on and after May 1 rates to consumers of the plant will be cut to bring about an annual saving of $21,000.

NEW YORK PUBLIC SERVICE COMMISSION has fixed the reduced electric rates to be charged by the municipal plant in the village of Tupper Lake. The new rates are estimated to save consumers of the municipal plant about $12,000 annually of which $7,000 will be saved by residential users and $5,000 by commercial and power customers. The order of the commission requires the village to make the new rates effective on May 1.

•

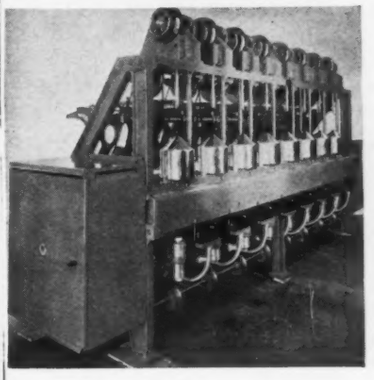
Make Exhibit Annual Event

Following the closing of the Better Homes Exposition held in Dayton, Ohio, the boards of directors of the Gas and Electric League of Dayton and the Construction League of Dayton voted to make the event an annual affair. In spite of the inclement weather, more than 10,000 persons visited the show.

•

G.E. Street-Lighting Film

The illuminating laboratory of the General Electric Company has recently released a sound slide film on street lighting to its lighting specialists, who will offer it to utilities throughout the country, according to E. L. Robinson. Titled "America's Fatal Streets," the film calls attention to the present automobile accident and fatality rate, then proceeds to demonstate how modern street lighting helps reduce this rate.



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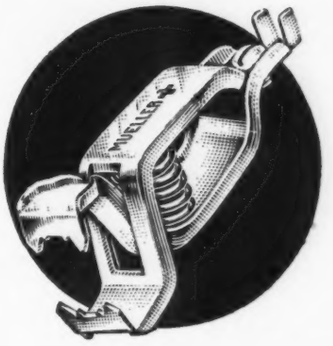

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—8 Different Sizes
—Both Steel and Copper
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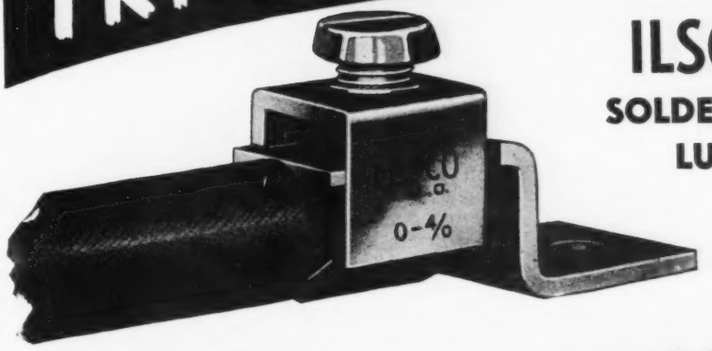

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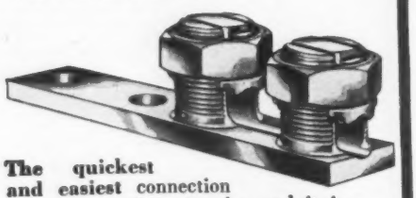
You carry *Only* 3 *Sizes* of lugs—

instead of 17—to take the complete **range of wire and cable sizes from No. 6 solid to 500,000 c.m.**
A truly "universal" lug, because each size can be used for a wide range of wire and cable sizes.



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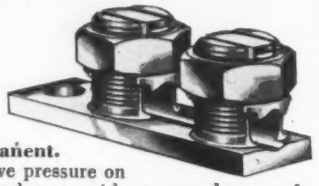

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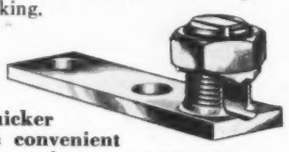

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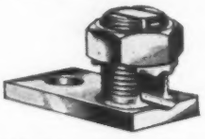

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Sales Opportunities

OLEUM, CALIF.—Pacific Gas & Electric Company, San Francisco, Calif., which recently announced plans for new steam-electric power plant at Oleum, for power supply for oil refinery of Union Oil Company of California, Inc., has recently secured permission to construct and operate similar power plants for service at oil refineries of Shell Oil Company, Martinez, and Tidewater Associated Oil Company, Avon, both Calif., each estimated to cost approximately $5,000,000.

HILL CITY, S. D.—Dakota Power Company, Hill City, plans new transmission line from generating station, known as Big Bend plant, on Rapid Creek to point near Hill City, about 15 miles. Surveys are under way.

CHILLICOTHE, MO.—Will take bids soon, closing on or about May 17, for extensions and improvements in municipal electric power plant, including equipment installation for increased capacity. Cost about $300,000. Henrici-Lowry Engineering Company, West Tenth Street Building, Kansas City, Mo., is consulting engineer.

DETROIT, MICH.—Parke, Davis & Company, 1 McDougall Street, plans installation of motors and controls, conveyors, electric elevators, regulators and other equipment in new seven-story addition to drug and pharmaceutical plant. Cost over $350,000. Bids are scheduled to be asked soon. Albert Kahn, Inc., New Center Building, Detroit, is architect and engineer.

SANTA MONICA, CALIF.—Southern California Edison Company, Los Angeles, Calif., has plans under way for new indoor power substation at Santa Monica. Company also has approved plans for addition to power substation at Chino, Calif., and will proceed with work on latter project at once.

DECATUR, ALA.—Closes bids on May 10 for a municipal electrical distribution system, with transmission line for connection with TVA high-tension system, from which power supply will be secured, including poles, wire and cable, pole hardware and fittings, etc. Cost estimated at $300,000. Financing has been arranged through federal aid. T. M. Francis, Brown-Marx Building, Birmingham, Ala., is consulting engineer.

BAY CITY, MICH.—Consumers Power Company, Jackson, Mich., has approved plans for extensions in primary and secondary lines in parts of Bay, Midland, Iosco and Alcona Counties, totaling about 33 miles, and will begin work at early date. Company also has plans maturing for extensions in lines in other parts of state, including about 7 miles of lines in Battle Creek area.

SIOUX CITY, IOWA—American Chemical Foundation, Atchison, Kan., plans installation of motors and controls, conveyors, electric pumping machinery, transformers and accessories, and other equipment in proposed new multi-unit plant at Sioux City for production of a new power alcohol motor fuel. Cost estimated over $400,000.

WISCONSIN RAPIDS, WIS. — Wisconsin Power & Light Company, Madison, Wis., has plans for turbine station addition at plant in vicinity of Wisconsin Rapids.

SACRAMENTO, CALIF.—Bureau of Reclamation, Sacramento, receives bids until June 1 for construction of Shasta dam and hydro-electric power plant, Central Valley project, Calif., about 14 miles from Redding, including installation of 4,120,000 lb. of drum gates and control mechanisms, 8,750,000 lb. of other gates and auxiliaries, 13,600,000 lb. of penstocks and outlet pipes and conduit linings, 3,200,000 lb. of trash-racks, 935,000 lineal feet of electrical conduit, 166,000 lineal feet of electrical cable, 36,000 lb. of ground wiring. Materials in part will be furnished by government (Specifications 780).

RIPLEY, TENN.—Plans new municipal electrical distributing system, with transmission line for connection with TVA high-tension system, from which power will be secured, power substation and operating facilities. Financing will be arranged through federal aid.

NEVADA, MO.—State Building Commission, Edgar M. Eagan, executive secretary, Bi-Partisan Board, Merchants' Bank Building, Jefferson City, Mo., receives bids until April 28 for 150-kw. a.c. generating unit and auxiliary equipment for installation in power plant at institution at Nevada. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

PRENTER, W. VA.—North American Coal Corporation, Union Trust Building, Cleveland, Ohio, plans installation of motors and controls, conveyors, electric hoists and other equipment for expansion and improvements in coal mining plant of Red Parrot Coal Company, Prenter a subsidiary organization. Cost about $300,000.

GLENDALE, CALIF.—Has authorized plans for new municipal steam-electric generating plant, with capacity of 15,000 kw., including extensions in transmission and distributing lines, and power substation facilities. Proposed to complete project in 1939. Cost over $1,000,000. E. A. Ingham is city manager in charge.

MASON CITY, IOWA—Peoples Gas & Electric Company, Mason City, has authorized extensions in primary and secondary lines in parts of Cerro Gordo, Floyd and Mitchell Counties, where rights-of-way and franchises are being secured, for rural electrification, totaling about 133 miles in all, of which over 120 miles will be in first two noted counties. Work will be placed under way this spring.

LA CROSSE, WIS.—Northern States Power Company, Eau Claire, Wis., will defer construction of proposed new steam-electric power plant on French Island, La Crosse, where site has been acquired, as previously noted in these columns, and proposes to begin work on project in 1939. Cost estimated close to $1,500,000.

NEW BERN, TENN.—Receives bids until April 28 for municipal electrical distributing system, including transmission line for connection with TVA system, source of power supply. Cost about $60,000. Financing has been arranged through federal aid. L. O. Brayton Engineering Company, Dyersburg, Tenn., is consulting engineer.

MILFORD, MICH.—Ford Motor Company, Dearborn, Mich., has authorized plans for new hydroelectric power plant at Milford, for service at branch automobile works at that place, and proposes to ask bids for power dam, power station and equipment at early date. Shreve, Anderson & Walker, Marquette Building, Detroit, Mich., are engineers.

BOOK REVIEWS

Electrical Machinery

By Terrell Croft, revised by George H. Hall. Published by McGraw-Hill Book Company, 330 West 42d Street. 394 pages, illustrated. Price, $3.

This is George H. Hall's revision of Croft's 1929 book on d.c. and a.c. machinery and deals with them in an elementary and practical way as to principles, operating and trouble elimination. Without mathematics, the reasons for characteristics are given and well illustrated. Up-to-date forms of generators, alternators, motors, converters, starters, rectifiers and speed controllers are presented. Abnormal performance is classified to facilitate decision as to the correctives as well as to correlate the behavior with the source within the machine. Formulas for all machines are collected in an eight-page appendix.

●

A Statement of Accounting Principles

Prepared by T. H. Sanders, H. R. Hatfield and Underhill Moore. Published by American Institute of Accountants, 135 Cedar Street, New York. 138 pages. Price, 75 cents.

In no industry is accounting more actively under study than among utilities because their books are practically a matter of public scrutiny on account of the many regulatory, taxing and underwriting bodies with which they deal. It is timely, therefore, that the professional accountants should set down what they consider the basic principles of accounting in order that varying and sometimes conflicting requirements can be tested against the fundamental objectives of financial records. This booklet meets that need. It was undertaken by the Haskins & Sells Foundation because corporation attorneys, stock exchanges, federal bureaus, state commissions, legislation, tax assessors should find the rudiments a common point of departure for progressively uniform details of requirements.

The book gives ample evidence of a comprehensive survey of all shades of authentic beliefs and escapes completely being merely the opinionation of the three professors commissioned to draft it. Consolidated statements for holding companies are accorded a brief chapter. Supporting court and other citations for all chapters comprise the final 22 pages.

●

Procedure Handbook of Arc Welding Design and Practice

Published by the Lincoln Electric Company, Cleveland, Ohio. 1012 pages, illustrated. Price, $1.50 (U. S. A., postpaid).

The first edition appeared in 1933; this, in 1938, is the fifth, showing how fast the art of arc welding has moved and, likwise, how diligently this practical handbook has kept up with it. Expansion of this edition has added or revised material on the Welding Society symbols, high-speed automatic welding, comparative costs (in terms of wire and time per foot), a discussion of generator characteristics, and many more illustrations of welding jobs. As a result the book is fully what it claims to be—not a theoretical—but a procedure guide for both designers and operators.

There are more than 1,200 illustrations and diagrams, of which at least 1,000 pertain to specific examples of welding for machine parts, structures, repaired members, etc. To a large degree the section on design for construction of machinery is a good practical treatise on design to meet working stresses as well as being educational in showing how to employ flats and rounds most advantageously as a substitute for casting or forging. Company advertising is confined strictly to the final twenty pages preceding a comprehensive index.

●

Industrielle Elektrowärme
(Industrial Electric Heating)

Part 2, 62 pages. Part 3, 116 pages. Published by Wirtschaftsgruppe Elektrizitätsversorgung, Berlin W62, Einemstr. 1. Price, each part 1 reichsmark.

Engineers and others concerned with application of electric heating will find material of interest in these convenient booklets. Part 2 shows methods for solving problems arising in the design of installations. Illustrative examples are worked out. Tables of physical constants of various heat conductors and insulators include data not readily available elsewhere. Part 3 of the series lists a large number of applications classified as to type of furnace or heating device and kind of industry. Part 1, previously published, dealt with electric welding.

●

Guides to Business Facts and Figures

Compiled and published by Special Libraries Association, 345 Hudson Street, New York, N. Y. Price, $1.50.

This booklet of 59 pages contains (1) a classified list of 235 publications giving statistics, annually or at shorter intervals, of value to the business world, supplemented by brief statements of their contents, price, name and address of publisher; (2) author and title index; (3) classified subject index referring to list (1) above. It should be a useful tool for engineers and others engaged in statistical and economic studies and may well find a place in company libraries.

●

Photo-Electric and Selenium Cells

By T. J. Fielding. Published by Instruments Publishing Company, 1117 Wolfendale Street, Pittsburgh, Pa. 140 pages, illustrated.

Experimenters were in the mind of the author, so he minimized the conflicting theory of operation of photocells and proceeded to a description of their amateur fabrication and typical characteristics, correlating both with those of commercial tubes. The second half deals with basic uses of the cells in television, "talkies," industrial, gramaphone and other applications. Counting, safety functions, precise gauging, sorting, elevator control, sign lighting control, smoke density, blind reading, crime prevention and race timing are a few of the uses pictured and described in this brief and elementary book. It is stated that transatlantic liners are equipped to take fog-piercing photographs by means of photocell and infra-red rays, the developed views being available within a minute.

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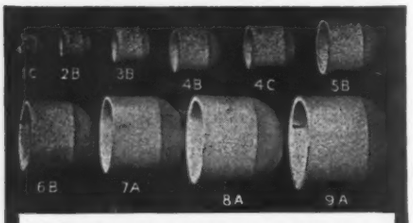

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The TVA Jury Record

[*Continued from page 90*]

made a fuss over Joe on the platform, in plain view of way station audiences. Finally Schwartz had to get Joe to introduce him to Mrs. R. Which everybody in Wyoming knew before nightfall.

Senator Lynn J. Frazier (R), North Dakota—Really more a Non-Partisan Leaguer than a Republican. Strong for government ownership and politically an implacable foe of the "vested interests." Does not spout the fireworks which his background as three times governor of North Dakota would make Senate audiences expect. In fact, has taken his senatorial chores rather soberly, and has mellowed much in the fifteen years he has served in the upper house.

Senator James J. Davis (R), Pennsylvania—Secretary of Labor under Presidents Harding, Coolidge and Hoover. Born in Wales. He was an iron puddler in Sharon in his teens. Belonged to nearly all the secret orders and ran the Moose for years. Most dependable Republican. Conservative and anti-New-Deal vote in the upper house. Usually not aggressive, but thinks he has a chance for re-election in Pennsylvania this year and so may try to provide a few fireworks in the investigation.

Representatives

James M. Mead (D), New York—Chairman of House post office committee. So loyal to the Administration that while his Democratic colleague from Buffalo switched against the President in response to back home sentiment, Mead stood pat. Has never been interested in TVA, but will do whatever Administration wants providing it does not require too much time from his other interests. Chief investigating committee experience was in ocean mail contracts, on which he is credited with having done a good job. Strong labor leanings and very likable person.

William J. Driver (D), Arkansas—Able and independent. Judicial temperament. As member of powerful House rules committee has bucked President on wage-hour law. Voted against President on reorganization bill. Tremendously interested in federal flood control. Inclined to be pro-Administration if his judgment and conscience permit.

Thomas A. Jenkins (R), Ohio—Appointment a big surprise, because he had said TVA was a "stench in the nostrils of the people" when demanding an investigation. He has also eulogized Dr. Arthur E. Morgan. He voted against the original TVA bill and against the amendments in 1935. Also against the Gilbertsville dam this session. On the other hand, has fought for appropriations for his district for rural electrification. Would like to run for governor of Ohio, but hasn't much chance of nomination this year. One Administration leader said privately his "fizzling would not only be impotent, but would create reaction other way."

Charles A. Wolverton (R), New Jersey—Curious combination of voting regular Republican, conservative and anti-Administration, invariably, but consulting David Stern, radical pro-New Deal publisher, before making up his mind about anything. Stern prints a paper in Camden, in Wolverton's district, as well as in Philadelphia, right across the river. Was approved by the Republican House leaders because he is regarded as ablest cross-examiner at south end of Capitol.

Robert E. Thomason (D), Texas—Had plenty of experience dealing with privately owned utilities while mayor for four years of El Paso. Strongly pro-Administration, voting with White House on reorganization bill. Says himself he is "independent and impartial." Ability highly regarded by colleagues.

•

Output in First Quarter

"Preliminary figures of electric output of North American subsidiaries so far this year reflect a continuation of lessened demand for power by industrial customers," said J. F. Fogarty, president of the North American Company, in the quarterly report of electric output of subsidiaries. Output for the first quarter of 1938 was approximately 1,485,000,000 kw.-hr., 8 per cent less than the all-time peak output of present subsidiaries for the first quarter of 1937. However, it exceeded the output for the first quarters of 1936 and 1935 by about 3 per cent and 13 per cent, respectively.